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CONTENTS

CONTRIBUTIONS, ABSTRACTS, AND BIBLIOGRAPHY

WEATHER OF THE MONTH

CHARTS

† In marine Separate.

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PRECIPITATION IN THE DRAINAGE AREA OF THE GREAT LAKES, 1875–1924

WITH DISCUSSION OF THE LEVELS OF THE SEPARATE LAKES AND THEIR RELATION TO THE ANNUAL PRECIPITATION

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SYNOPSIS

Owing to extensive discussion of lake levels and the causes controlling them, the precipitation data of the Weather Bureau and the Canadian Meteorological Service for the drainage basin of the Great Lakes have been examined with care. From 1875 trustworthy determinations are possible. The precipitation averages about 32 inches per year, and in general increases from north to south. As a rule the stations considerably above the levels of the lake surfaces indicate more precipitation than those close to the lake levels. The lake surfaces probably receive about as great precipitation as do stations at or near the shore, the deficiency in catch in gages exposed on islands or peninsulas being considered as due to increased wind effect.

The precipitation was unusually heavy, on the average, from 1875 to 1885, and the period 1875 to 1899 shows more precipitation at almost every station than the period 1900 to 1924. However, there were groups of a few successive years with scanty precipitation before 1900, one, indeed, before 1890. From 1917 to the present nearly the whole area has had decidedly scanty precipitation. It is not believed that removal of the forest cover has materially affected the amount of water reaching the lakes.

The water levels seem to be closely related to the quantity of precipitation, delays of a year or more often appearing in the response of the levels, since the run-off is not immediate. It is highly improbable that the deficient falls of recent years indicate permanent or semi-permanent establishment of scanty supplies of precipitation. A return over several years to the normal quantity of precipitation or to even greater amount may be expected to end the present prevalence of unusually low levels in the lakes, just as various periods of low water during the nineteenth century were terminated by generous rainfall.

OUTLINE OF SUBJECTS

PRECIPITATION DATA USED IN THIS INVESTIGATION

Development of precipitation observations in the Great Lakes region.—The official collection of daily weather statistics, including measured precipitation, in the United States for the purpose of issuing forecasts of probable weather conditions, began in the latter part of 1870, when steps were taken to secure reports from a group of stations as well distributed over the country as was then possible.

On account of the growing importance of the Great Lakes as commercial highways at that time, and the rapid development of important business centers along their shores, more stations per unit area were established in this region than in other parts of the country. It is therefore possible to secure a more accurate estimate of the distribution of precipitation in this region during the early years of the Government Weather Service than elsewhere.

At a few points in this region the Army Medical Corps was already taking weather observations, as were also individuals and important observatories in cooperation with the Smithsonian Institution at Washington.

About the same time meteorological observations were begun on a rather extensive scale in Canada, and a number of stations were established on the Canadian shores of the Great Lakes or within their drainage areas.

In subsequent years, more observing stations of the two Government weather services were established as needed for forecast work, and, in addition to these, an extensive system of cooperative weather stations was gradually built up, so that for many years the entire drainage area of the Great Lakes has been covered by such a network of stations that it is possible to determine closely the daily, monthly, seasonal, or yearly distribution of precipitation over all its parts.

Length of record and distribution of stations.—In making this study it appeared desirable that the period covered should be sufficiently long to embrace all probable phases of precipitation distribution, including even those frequently assumed to recur over well-defined short or moderately long periods. Moreover, a good distribution of stations was necessary in order that the separate lake basins and the drainage area, as a whole, should be represented. This, of course, was only possible by reducing all the records to a homogeneous system, each station to cover the entire period of years.

In examining the available data for the early years it soon became apparent that a period of heavy precipitation existed during those years over the Great Lakes, particularly during the 10-year period beginning about 1875. Although few stations were in operation during this period over much of the Superior basin, as well as over smaller areas in some others, it was clear that the period should be included in any discussion of the variations in precipitation from normal, even though extensive interpolations were necessary to determine the probable precipitation.

In view of the above, it appeared best to limit the discussion to the 50-year period beginning 1875 and ending 1924, as this length of period would doubtless embrace the limits within which the precipitation might be expected to fluctuate, and would likewise disclose any tendencies toward the so-called recurring short-period cycles, should such exist. Also by 1875 the reporting stations had become sufficiently well distributed to make possible a reasonably correct estimate of the precipitation over areas not then fully represented, and from which actual data would soon become available. Brief notes of leading features of 1925 have been included since that year ended.

During the early years of the period the records, except those maintained for forecast purposes, were frequently broken. New stations were constantly being opened, however, so that moderately accurate charts of monthly and annual precipitation for the greater part of the region are available for all the years.

It was not possible to secure for the purposes of this study as good distribution of stations over the Lake Superior area as elsewhere. Moreover, it was desired that each station, even though its record was not continuous through the 50 years, should nevertheless represent a distinctive area, embracing frequently several stations with records for different periods, but so located as to justify the assumption that they represented the precipitation of the district. In such cases the name of the station having the longest record or most centrally located was adopted for the locality, to which was added the word "near," thus indicating that the record is a composite of records made at the central station and at near-by points. In cases of broken records at these stations, missing months or years were supplied by interpolation from the corresponding monthly or annual charts, or as described below.

In localities where the lack of stations in the early years precluded interpolation from the charts, a station with the longest record, usually from 30 to 40 years or more, and best located for the purpose, was selected to represent the region, and precipitation ratios were established between that and the nearest full-record stations. From these ratios, values for the earlier years at the short-record station were estimated, it being assumed that, on the average, the ratios existing between near-by stations over a considerable period will continue indefinitely. It was generally possible to secure ratios of a short-record station to two or occasionally three favorably located full-record stations, thereby insuring a reasonably accurate estimation.

With these estimated values, together with figures from the stations having complete records, it was possible to assemble data from nearly 100 points covering all areas of the several watersheds for the full 50-year period.

The data for stations marked "near," where derived partly from those at near-by points or even where interpolated from the monthly or annual charts, have not been specifically indicated as interpolations, as they are considered as representing the districts with sufficient accuracy for the purpose. Interpolated data determined by the ratio method have been indicated in all cases.

Exposure of instruments.—In studying precipitation data with a view to determining possible changes in the amounts received over long periods of years, it is essential that uniformity shall exist in all the details covering the final catch, including pattern of measuring gage, identical exposure throughout the period, and such factors as elevation above ground and character of surroundings, any material variations in which may seriously impair the value of the record.

Fortunately the gages used have been approximately uniform in pattern throughout the period, but their exposure has been far from ideal and has varied greatly at many of the stations. This is particularly the case with the important telegraphic-reporting stations of the bureau where local business conditions have required many changes in the locations of the gages, chiefly resulting in higher elevations, in efforts to escape the serious effects on the catch by the constantly increasing heights of near-by buildings.

At subordinate or cooperative stations, conditions usually have been more uniform, these having mostly ground exposures, but frequent changes have been necessary in the locations of the gages, due to changes in observers. However, with the large number of stations these disturbing factors tend to a counterbalancing of effects, and the final averages probably closely approximate the actual precipitation for the respective localities.

FACTORS INFLUENCING THE AMOUNT AND DISTRIBUTION OF PRECIPITATION IN THE GREAT LAKES REGION

Effect of water surfaces on precipitation over adjacent land areas.—There has been much discussion concerning the effects of near-by large bodies of water on local climate. It is known, of course, that the presence of water tends to equalize local temperatures, the effects being largely in proportion to the size of the water area and its location with regard to prevailing winds, proximity to mountains, etc. In the case of precipitation, however, the relations are more obscure and in order to determine as far as possible the facts for the near-by land as well as over the water surfaces of the Lake region, Figure 1 has been prepared. This chart is based on a period of 10 years only, 1915 to 1924, inclusive, but has been prepared from the record for every station in the region having observations for those years. As these stations are mostly cooperative they practically all have ground exposures for their gages and present a group of mainly homogeneous data observed under conditions that should show with much accuracy the variations in precipitation due to local topography, proximity to bodies of water, etc.

The figures showing these averages for the 10-year period, together with the elevations of the stations above sea level, have been entered on the chart for convenience in studying the variations due to local environment.

Considering the *Michigan-Huron area* alone, ideally located in the main storm track of the country, and moderately free from important elevations to affect the free movement of the winds, it offers an excellent opportunity to determine closely the influence of water bodies and moderate elevations on precipitation.

From the data for the two sides of Lake Michigan between latitudes 42° and 45° north, we are enabled to outline three nearly equal areas on opposite shores of the lake having about equal numbers of stations and apparently almost identical elevations and surroundings. The average annual precipitation, for the 10-year period, of the three areas from north to south on the western shore are 31.2, 31.5, and 32.2 inches, respectively, while on the eastern shore in the same order they are 31.6, 31.8, and 32.7, amounts larger by 0.4, 0.3, and 0.5 inch, respectively. These differences in the annual amounts are so slight that it is apparent the interposition of this body of water has but little effect on the distribution of annual precipitation on the opposite shores; though there is a slight tendency

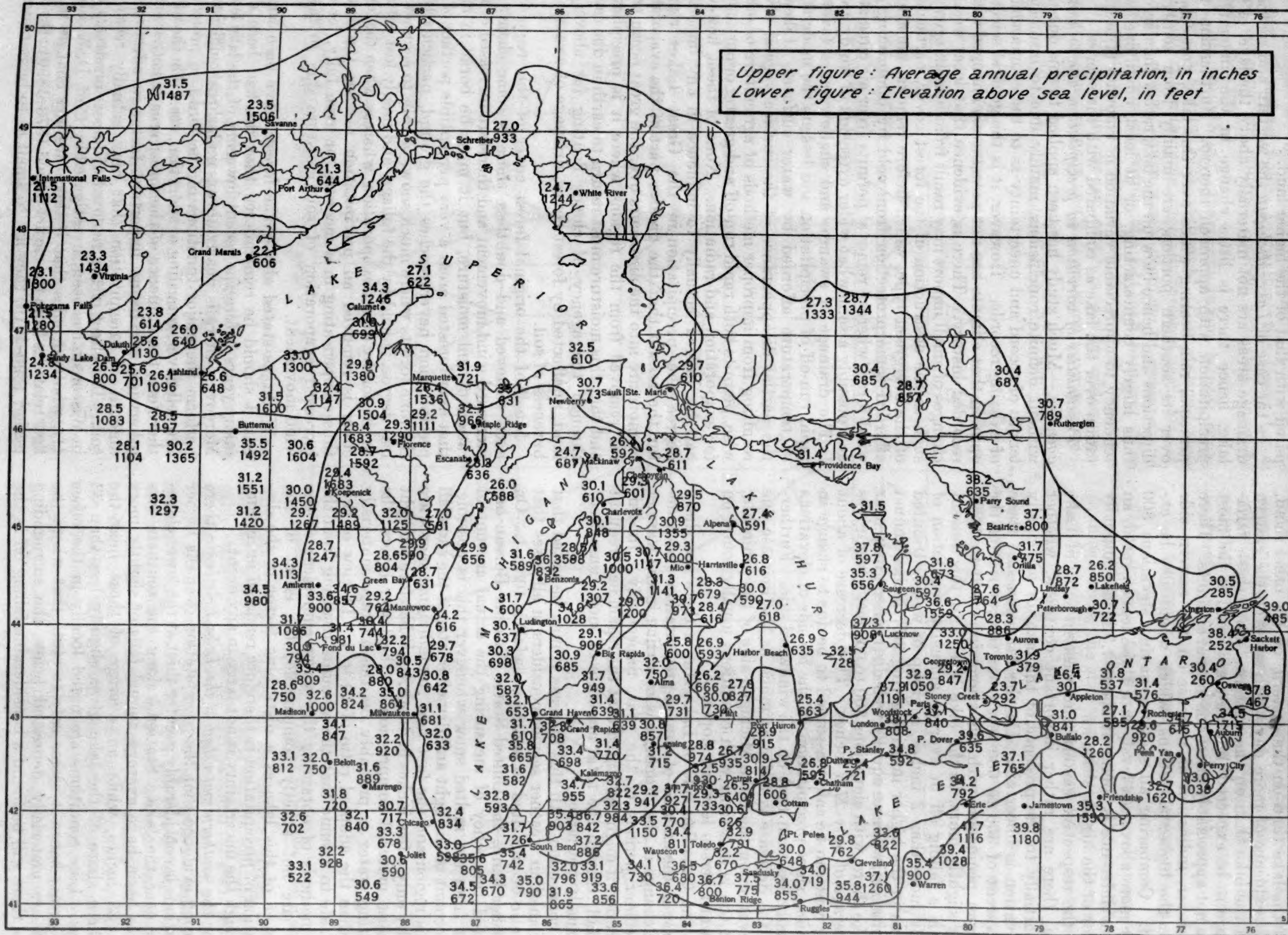

FIG. 1.—Average annual precipitation over the Great Lakes drainage basins, 1915–1924, and elevations of stations

toward more days with thunderstorms on the western side of the lake than on the eastern; on the other hand, there is evidence of more days with snow on the eastern side of the lake than on the western. Both these variations are to be expected, but they are small at the most and do not appreciably affect the annual amounts. There is, however, indication of increase on the eastern side due to the higher elevations, which would also be expected. Comparing all stations having elevations 800 feet or more above sea level, with those less elevated, an average difference is found of about 1.5 inches annually in favor of the higher altitudes.

On the respective eastern and western sides of Lake Huron, there are rather important contrasts, whether due partially to the presence of the lake, or principally to elevation is uncertain. On the Michigan side there is a descent of 300 to 600 feet from the interior of the Michigan peninsula, with elevations from 900 to 1,200 feet or slightly more, to the lake level. In this descent there is a falling off in average annual precipitation of slightly more than 3 inches, a group of well-distributed stations in the higher interior giving 30.7 inches annual precipitation, while an equally well-distributed group near the lake shore, with elevations 300 to 600 feet lower, gives an average of only 27.6 inches. This decrease of about 10 per cent can be safely assumed to be due to change in elevation, since precipitation on the lee side of elevations is usually less than that on the windward side. Furthermore the decrease is twice as much as the increase due to elevation on the Lake Michigan side of the peninsula, which, too, is in accord with conditions usually found on windward versus leeward slopes.

On the Canadian side of Lake Huron there is a sharp increase in the amount of annual precipitation and a decided change in the proportions occurring in the warmer and colder periods of the year, respectively. In this connection it might be stated that the region has frequent snowfall, though the total amounts of snow (unmelted) are usually not large.

In connection with this increase it may be noted that the Canadian weather service considers in all cases that the ratio of unmelted to melted snowfall is 10 to 1. On the other hand, the United States Weather Bureau has adopted the policy of measuring the actual amount of water from the melted snow whenever this is possible. On account of the light and dry character of the snowfall in this region and the fact that the individual snows are usually only a few inches in depth, and therefore too light to cause material compression of the lower layers, the resulting water is probably on the average materially less than the adopted ratio of 10 to 1. In view of this it is safe to assume that the amounts resulting from the two methods of obtaining the water equivalent of the snow are not strictly comparable; the effect of the presence of this lake as a disturbing factor in the distribution of precipitation is therefore rendered uncertain, although the uncertainty is not large in any event.

For the *southern watershed of the Lake Erie basin* there is strong evidence that the precipitation over the higher elevations is considerably greater than at the lower elevations near the lake. Stations along the southern rim of this basin have average annual falls of slightly more than 38 inches, while an average of those near the southern shore of the lake gives slightly less than 33 inches. Like conditions are noted locally in the other lake areas; hence it seems safe to state that where the lakes are materially depressed below the surrounding lands there will be found a considerable falling off in the precipitation over the near-by water surface as compared with that of the higher land.

In the case of *Lake Michigan* the western and southern drainage areas are not materially above the level of the lake, hence there is little change in the amounts of precipitation with approach thereto. Furthermore the principal rain-bearing winds over this lake, particularly over its southern portion, are mainly from southerly directions and hence blow up the lake rather than across, thus largely counteracting, or at least modifying, any tendency to appreciable variation in amounts of precipitation over the lake as compared with the shores.

Possibilities of variation in precipitation due to human agencies.—Much study has been applied to this question without definite conclusions, mainly due to insufficient length of record and uncertainty as to the comparability of existing records. However, it is the general scientific opinion that climate has not *permanently* changed within recorded history. There is evidence that local weather changes of small import may result from human agencies, such as the destruction of the forest cover, particularly of the evergreen type, which before removal must have afforded some protection from cold by diminishing the wind force, whereas removal permits freer air circulation and possibly a somewhat wider extension of windy areas.

The drainage of swamps and shallow lakes favors a rapid run-off of precipitation and lessens the moderation of temperature afforded by water surfaces. Likewise the partial disappearance of the surface vegetal cover, resulting from improper methods of agriculture or otherwise, permits both rapid run-off and greater opportunities for evaporation and radiation. None of these, however, can be judged actually to influence in any important degree the precipitation in the Great Lakes region. for the reason that the greater part of the evaporation of moisture into the air occurs over the great ocean areas far removed from the regions where it is precipitated, and that this moisture must return to earth in due course through the agency of clouds floating far above the land, unaffected by forest cover, drainage of swamps, or bareness of soil.

Much of the original forest cover of this region has been removed and doubtless there is some chance for increased wind movement and therefore increased evaporation of soil moisture, but it must be borne in mind that over forested areas a very perceptible portion of the precipitation never reaches the ground, particularly in the pine forests where much snow, or rain to a somewhat less degree, is held by the foliage, and finally lost entirely to the soil by direct evaporation, whereas when the forest cover is removed all precipitation reaches the gound, thus compensating in a measure, or even fully, for any increased evaporation of soil moisture due to higher wind movement.

While, as stated above, the forests have been largely cut, it should be remembered that this had been done many years before the recent lowering of the lake levels. Moreover, there is nearly always underbrush sufficient to perform the major functions of the forest in protecting the soil cover, retarding evaporation, etc. On the whole, therefore, the influence of the forest area, whether cut or otherwise, can be no important factor in affecting the amount of precipitation that may actually reach the soil. The effect of the removal of forests on stream flow in Wisconsin has been investigated by Prof. D. W. Mead, (*1*), who concludes that if there are any changes in the flow relations from the earlier period 1870–1890 to the later period 1890–1910, they are so small as to be immaterial.

As a check upon the possible change in precipitation due to deforestation, drainage of swamps, lakes, etc., the records of several points in or near the Great Lakes area covering the longest periods available, may be cited. (See fig. 2.)

At St. Paul, Minn., the precipitation record covers 88 years, 1837 to 1924, inclusive. This station, while probably not in the area originally forested, is close to it, and in a region where much drainage of swamps and lakes has occurred within the last half century. The average annual precipitation for the first 44 years was 27.26 inches, while the last 44 years, during which practically all the drainage and deforestation have occurred,

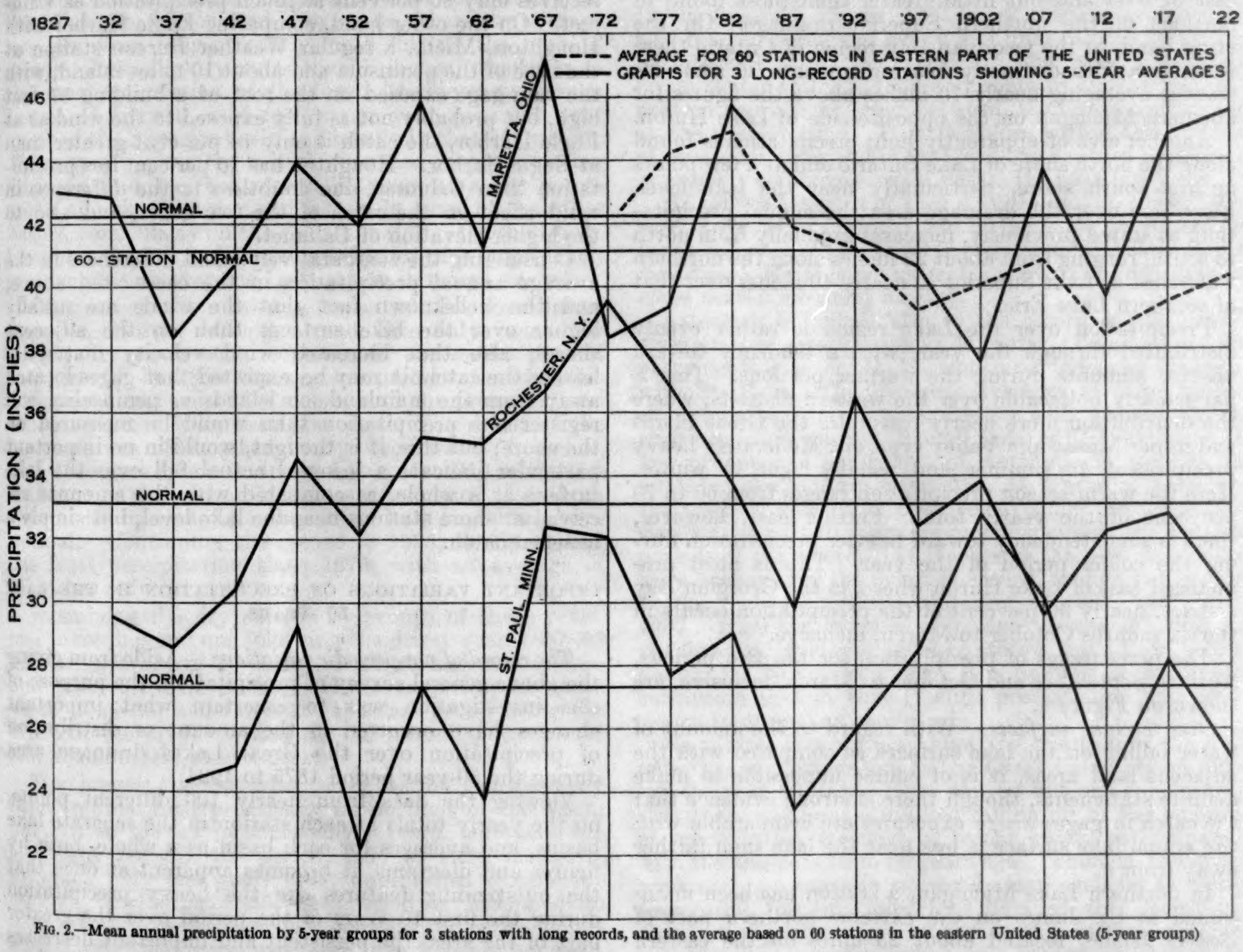

FIG. 2.—Mean annual precipitation by 5-year groups for 3 stations with long records, and the average based on 60 stations in the eastern United States (5-year groups)

show an annual average of 27.38, or a trifle more than when the original conditions existed.

At Marietta, Ohio, there are practically complete records of precipitation for 100 years, 1826 to 1925, inclusive. This locality, heavily forested at the beginning of the record, has been largely denuded. Here the average annual precipitation for the first 50 years was 42.35 inches, while during the last 50 years it was 42.05. Likewise at Rochester, N. Y., a record of 96 years, 1829 to 1924, shows an average during the first 48 years of 33.42 inches, while the last 48 years shows 32.75 inches.

The records for these three points—St. Paul slightly west of the upper Lakes; Marietta, south of them but comparatively near; and Rochester at the eastern end of the chain—show conclusively that in the past 100 years there has been little change in the precipitation. The assumption that deforestation, drainage, or other human activities have influenced appreciably the amount or distribution of precipitation over the area under discussion is therefore without substantial foundation.

REGIONAL DISTRIBUTION OF PRECIPITATION

Over the Great Lakes drainage basins.—For convenience in studying the distribution over the individual lake drainage areas, the stations selected have been arranged in alphabetical order and progressively by States around each lake, thus bringing all the data applying to each lake into separate tables, with a summation into a single table showing the average precipitation for each year for the entire drainage area (See tables 2–6 at end of paper.)

The Great Lakes are located on the main highway of storms having their origin in the northwest, west, or southwest, and moving eastward toward New England and the St. Lawrence Valley. In general they have more days with precipitation than any other portion of the country, save a small area along the coasts of Oregon and Washington, the number of days with precipitation ranging from about 100 over the western drainage of Lake Superior to nearly 175 over portions of the Ontario basin.

Precipitation from individual storms in this region is rarely heavy, amounts as much as 1 inch per hour occurring on the average not more than once per year at each station, while amounts of 2 inches or more in 24 hours do not occur more frequently.

In Figure 3 is shown graphically the general distribution of annual precipitation over the Great Lakes region, based upon the 50-year averages of all the stations.

In general, precipitation increases southward from the upper to the lower Lakes, though there are well-marked exceptions, notably near the shores of southern Lake Huron, on both the Michigan and Canadian sides, where the annual averages are nearly 5 inches less than further east or west and but little greater than those found in portions of the northern Superior drainage. On the other hand, in the Georgian Bay region of Ontario there is an area with distinctly heavier amounts, in some instances averaging nearly 10 inches above the figures for northern Michigan on the opposite side of Lake Huron.

Another area of apparently light precipitation is found along the north shore of Lake Ontario and at a few points on the south shore, particularly near the lake level. Elsewhere over the drainage area the annual precipitation, as stated previously, increases gradually from north to south, ranging from about 25 inches along the northern watershed of Lake Superior to nearly 40 inches over that of southern Lake Erie.

Precipitation over the Lake region is rather evenly distributed through the year, with a tendency toward heavier amounts during the warmer portions. This is particularly noticeable over the western districts, where the distribution more nearly resembles the Great Plains and upper Mississippi Valley type, *viz:* Moderately heavy precipitation in summer and usually light in winter. Here the warm-season precipitation ranges from 60 to 70 per cent of the yearly total. Farther east, however, there is some tendency toward heavier precipitation during the colder period of the year. This is most pronounced east of Lake Huron where, in the Georgian Bay district, nearly 60 per cent of the precipitation occurs in the six months October to March, inclusive.

The percentages of precipitation for the two periods, April to September and October to March, inclusive, are shown on Figure 4.

Over the lake surfaces.—With regard to the amount of water falling on the lake surfaces as compared with the adjacent land areas, it is of course impossible to make definite statements, though there is strong evidence that the catch in gages where exposures are comparable with the actual lake surface is less near the lake than farther away from it.

In northern Lake Michigan, a station has been maintained at St. James on the extreme northern part of Beaver Island, located about 25 miles off the eastern shore, and approximately 50 miles from the western shore, for a period of about 20 years. Comparing identical years with Mackinaw City, on the adjacent mainland, it is found that St. James receives only 94 per cent as great precipitation as Mackinaw. Similarly, near the western shore of the same lake, on Plum Island, off the extreme northern end of the peninsula which separates Green Bay from the lake, a station has been in operation for a number of years. Comparing identical years with two stations on the mainland some 25 miles equi-distant northwest and southwest of Plum Island, it appears to receive only 92 and 96 per cent, respectively, of the amounts for the two shore stations, or 94 per cent of an average for the two stations, the same as in the preceding case.

On the southern side of Lake Superior the Keweenaw Peninsula just northeastward nearly 50 miles into the lake, at the extreme northern part of which is the station of Eagle Harbor, Mich. The gage at this station is located only a few feet above the lake on the immediate shore and exposed to the full force of the lake winds. At Calumet, about half way between the base and the extreme northern point of the peninsula, but located inland about 4 miles, there is a station also with ground exposure for the gage, but at an elevation more than 600 feet higher than at Eagle Harbor, and probably protected from the full force of the winds by the general forest cover. Comparing similar years of record, Eagle Harbor receives only 80 per cent as much precipitation as Calumet. On the other hand, comparing Eagle Harbor with Houghton, Mich., a regular Weather Bureau station at the base of the peninsula and about 10 miles inland, with the rain gage exposed on the roof of a building 57 feet high, but probably not as fully exposed to the wind as at Eagle Harbor, the catch is only 14 per cent greater than at Eagle Harbor. Houghton has 10 per cent less precipitation than Calumet, due doubtless to the difference in wind effect on the catch of the two gages, and also to the higher elevation of Calumet.

Considering the comparatively small differences in the average annual precipitation in the cases cited above, and the well-known fact that the winds are usually higher over the lake surfaces than on the adjacent shores, also that increased wind velocity materially lessens the catch, it may be expected that gages located away from the mainland, on islands or peninsulas, will register less precipitation than would be measured on the shore; but this, it is thought, would in no important particular indicate a lessened actual fall over the lake surface as a whole, as compared with the amounts received at shore stations near the lake level, but simply a lessened catch.

IMPORTANT VARIATIONS OF PRECIPITATION IN THE LAST 50 YEARS

The record of nonperiodic variations.—Aside from giving the above general survey of precipitation, the purpose of this investigation was to ascertain what important changes have occurred in the amount or distribution of precipitation over the Great Lakes drainage area during the 50-year period 1875 to 1924.

Viewing the data from nearly 100 different points, on the yearly totals at each station in the separate lake basins, and averages for each basin as a whole, both by figures and diagrams, it becomes apparent at once that the outstanding features are the heavy precipitation during the first 10 years of the period over the greater part of the area, the persistent and important decreases during the following few years, the rather steady, but, on the whole, diminishing annual totals for the period about 1896 to 1916, and the marked decreases in practically all the region since 1916, including 1925.

The heavy precipitation occurring in the early years is not peculiar to the lake region alone, as is shown by figure 2.

This gives the average precipitation for five-year periods from 1872 to 1924, inclusive, over the eastern two-thirds of the United States, based upon the records of 60 well distributed observation points in that area.

For a period of about 10 years, 1875 to 1885, the precipitation for this area averaged nearly 45 inches, whereas during the remainder of the period the averages are mainly only slightly more than 40 inches or even less.

In the tables and diagrams showing the precipitation over the combined lake areas, as well as on the separate lakes, similar conditions appear and the same holds good for the individual long-record stations, particularly in the Superior, Michigan, and Huron basins, where, with two or three exceptions, all stations show much heavier precipitation during the early years.

Dividing the adopted 50 years of record into two periods of 25 years each, 1875 to 1899, and 1900 to 1924, inclusive, and charting the differences between the two sets of averages for all the stations (see fig. 5), it becomes evident at once that a large deficiency has accumulated during the later period over the greater part of the basin, the area of important losses embracing practically all the Michigan, Huron, and Erie basins, where the average loss per year ranges from 3 to 8 inches, the area of greatest loss, slightly more than 8 inches, occurring in the northern portion of the lower Michigan peninsula. Losses of from 2 to 4 inches per year occurred over much of the Superior basin and locally in that of Ontario. There was apparently a slight increase in precipitation during portions of the second 25 years at a few points north of Lake Superior and locally in some of the other basins, particularly on the Canadian side. On the whole, however, there is indisputable evidence of a large deficit in precipitation over the Lake region in recent years.[1]

Considering the drainage areas of the four lakes, Superior, Huron, Michigan, and Erie only, some unusually dry years occurred, even in the earlier part of the period. In 1888 the average precipitation for this entire area was only 29.6 inches, and the preceding and following years were nearly as dry. The driest of the 50 years was 1895, when the average was 27.6 inches, and 1894 was likewise dry.[2] The year 1910 with 27.8 inches was the second driest of the period, but both the preceding and following years had amounts above normal. Continuing the record to 1925, that year had the least precipitation since 1875, with an average of 27 inches only.

Examining the dry periods by groups of three years, one preceding and one following the driest year, 1887–89 had an average of 30 inches, 1894–96 had 29.8 inches, and 1909–11, 31.7 inches. However, the past three years, 1923–25, had but 29.2, this last group being the driest in the 51 years, and the six preceding years also had amounts less than normal.

The longest period with precipitation continuously below normal over practically all portions of the basin, but not so low as in some single years, embraces the last eight years of the period, 1917 to 1924, inclusive, in which only one year, 1921, approached closely the normal. Including 1925, the period is increased to nine years. The average deficiency for the entire watershed during this period was more than 2 inches per year, and ranged up to 6 inches or more in some portions. (See fig. 6.)

The possibility of periodic variations.—No other weather element varies so greatly as precipitation, nor has its upper limit been ascertained. Like other weather elements, however, despite its wide variation, precipitation always tends to return to the amount common to the area considered. The Great Lakes region is as free from violent fluctuations of precipitation as any other part of the country; nevertheless, there are material variations in the yearly amounts, and it is probably within the limits of good judgment to state that periods of marked excess of precipitation will usually be followed by changes to the opposite condition, and that these swings may at times be effective over 5 to 25 or more years. Probably the best guide to future conditions is knowledge secured by a careful survey of the past.

A record of 50 years' annual precipitation is far too short to establish any conclusion as to the length of these periodic swings, but the 88 years of record at St. Paul, Minn., referred to previously, may again be examined. In the five-year groups in Figure 2 there is evidence of well-marked periods of heavy and light rainfall recurring at intervals of 20 to 30 years. The more important crests center at 1847, 1868 and again in 1902, while important depressions occur between, the latest continuing at the present time. It is therefore within the bounds of precedent to expect in that locality, a return to normal or possibly to above normal within the next few years.

As regards the effect of such a return on lake levels, however, the evidence indicates that owing to the characteristic lag in response of lake levels to precipitation, the lake stages would probably go lower unless the increase of precipitation above normal were very marked.

Attention is invited also to the record of 100 years' precipitation observations at Marietta, Ohio, and the 96 years' at Rochester, N. Y., shown on the same diagram with St. Paul. The five-year averages at these places show long periods of precipitation with general trends above or below normal, though there is little evidence of any pronounced recurrence of wet and dry periods at anything like uniform intervals. At Marietta, however, the trend is upward at the present time, the precipitation for the past 10 years approaching closely the wettest periods of the record. At Rochester the past five years have been among the driest of record, though not so dry as the five-year periods centering at 1837, 1887, and 1907. Here the trend is at present downward, and as the five-year averages of precipitation have been below normal for 20 years or more, it is perhaps an allowable conclusion that in this locality precipitation will soon return to normal or above.

No matter how we may view the question of the distribution of precipitation in the Great Lakes region during the past 50 years, there can be but one conclusion: that there has been a marked falling off in the amount of precipitation received in recent years, as compared with the amounts 40 to 50 years ago. There is, however, apparently no cause to suspect human agencies as being responsible for any important part of this lessening. Nor has any other area of the earth's surface suffered within recent times a permanent important change of climate, a fact indicated by the rate of forest growth, which appears to have been not greatly variable for hundreds or even thousands of years, and by the agricultural products which have in many cases remained unchanged since earliest times. It is therefore safe to predict that fluctuations in the amounts of precipitation over this region will occur in the future as in the past, and we shall again experience the generous distribution received during the earlier years of rainfall measurement in this region.

[1] This is also true for the United States as a whole.—Editor.

[2] The diminishing precipitation in the lake region during the years 1894–95 was common to the eastern and central portions of the United States, the drought years seemingly progressing from the Mississippi Valley eastward.—Editor.

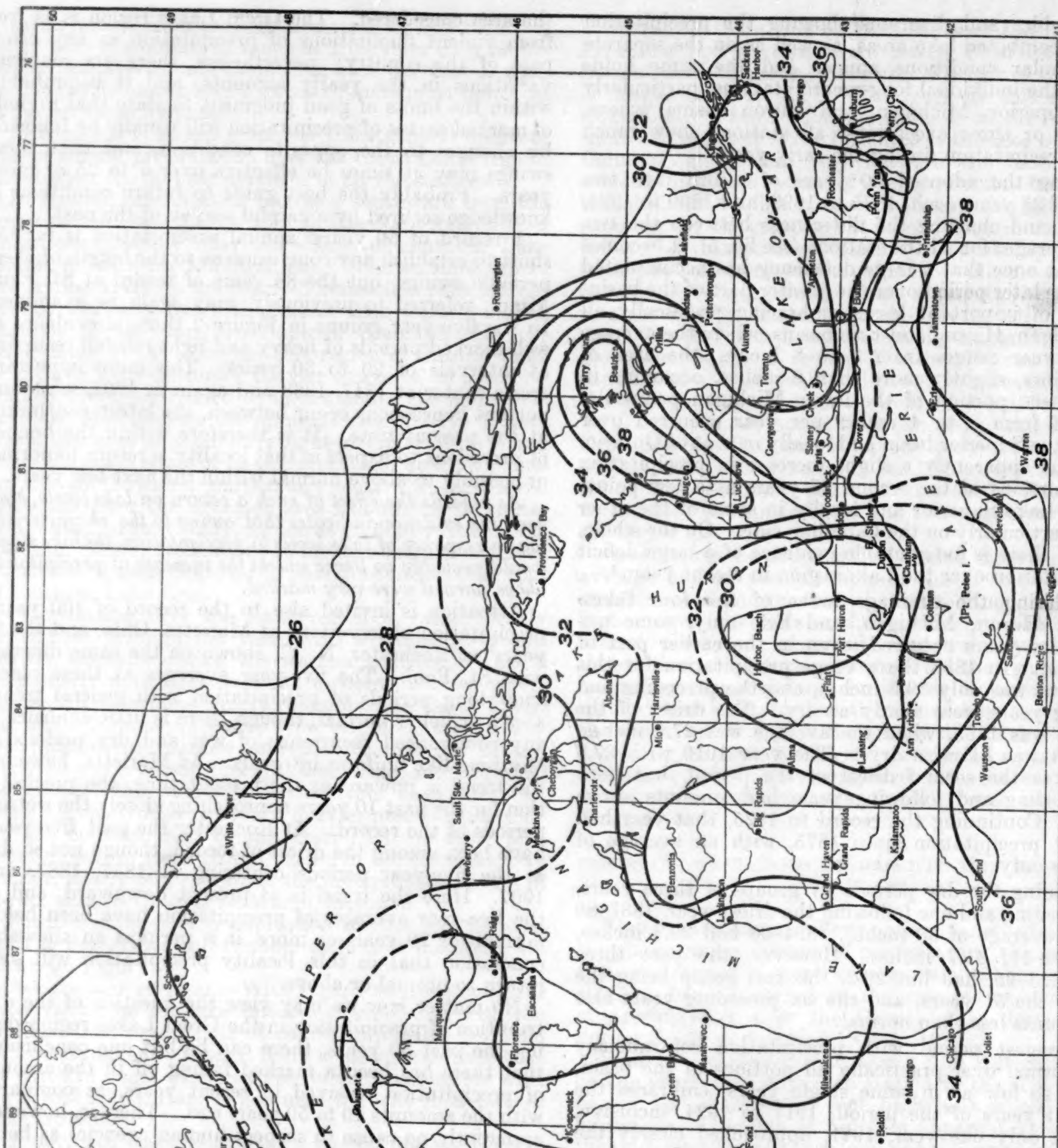

FIG. 3.—Mean annual precipitation (inches) in the Great Lakes region, 1875–1924, inclusive

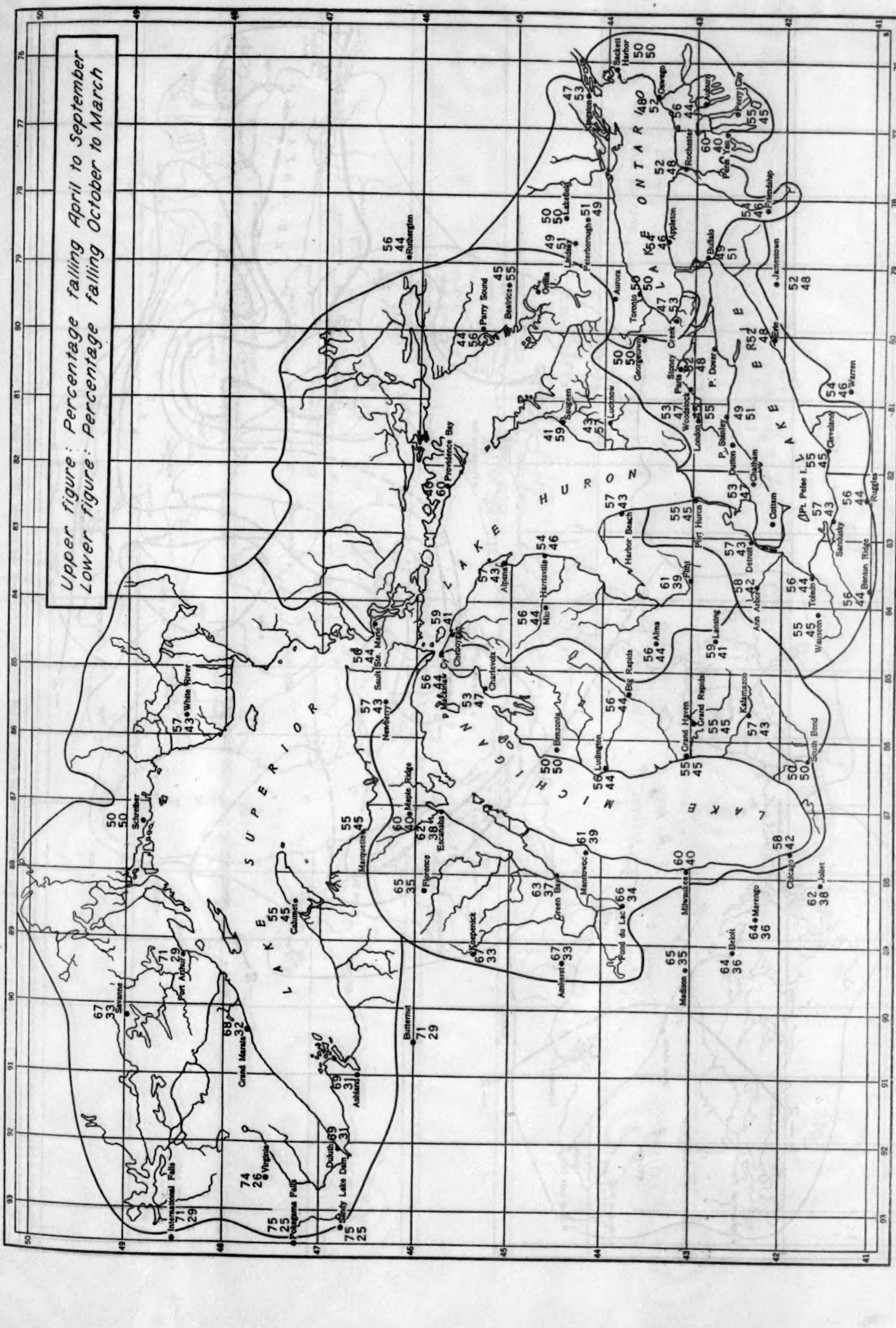

FIG. 4.—Average percentages of precipitation occurring in the two half-years, Great Lakes region

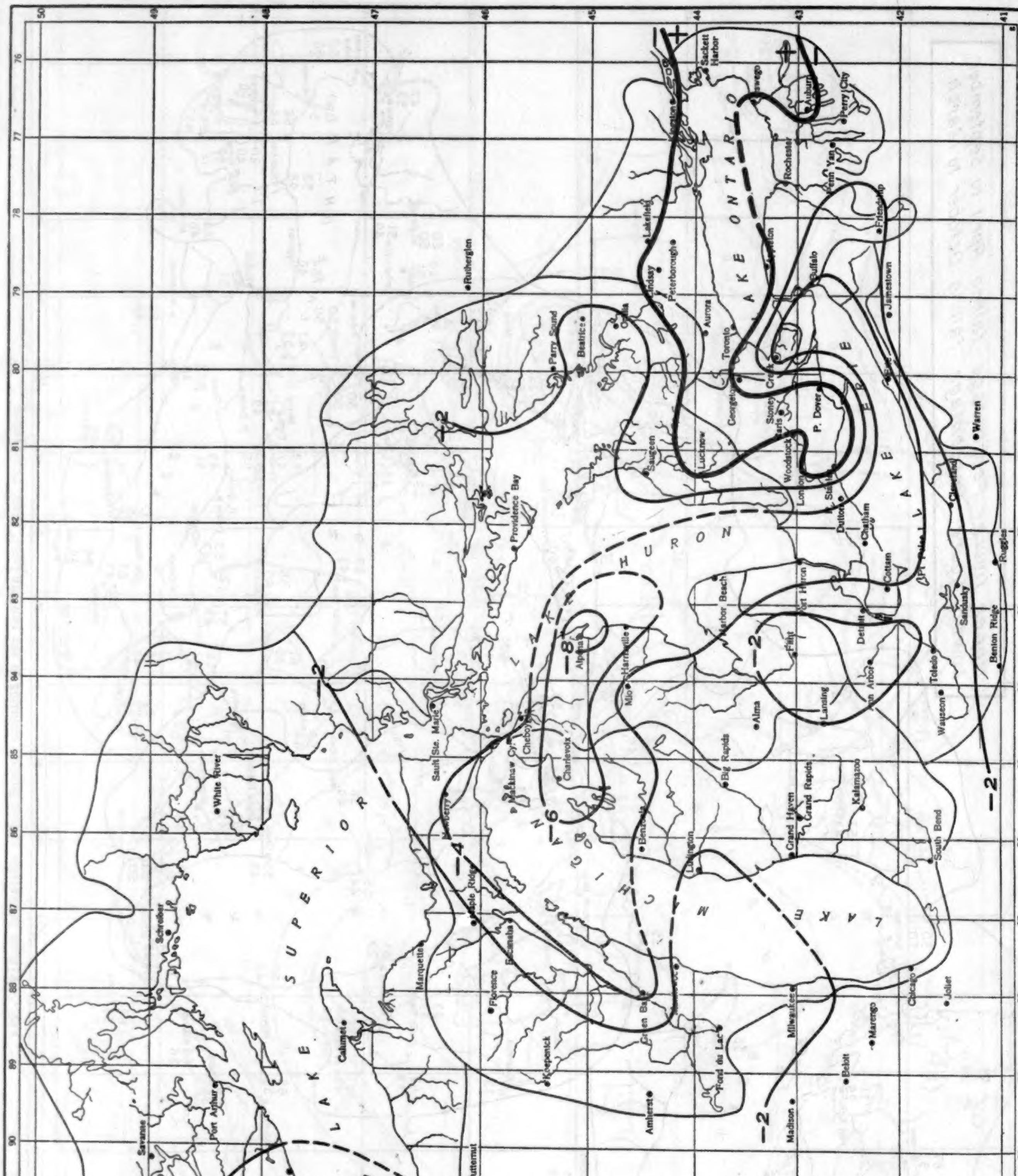

FIG. 5.—Difference in mean annual precipitation between the periods 1875–1899 and 1900–1924

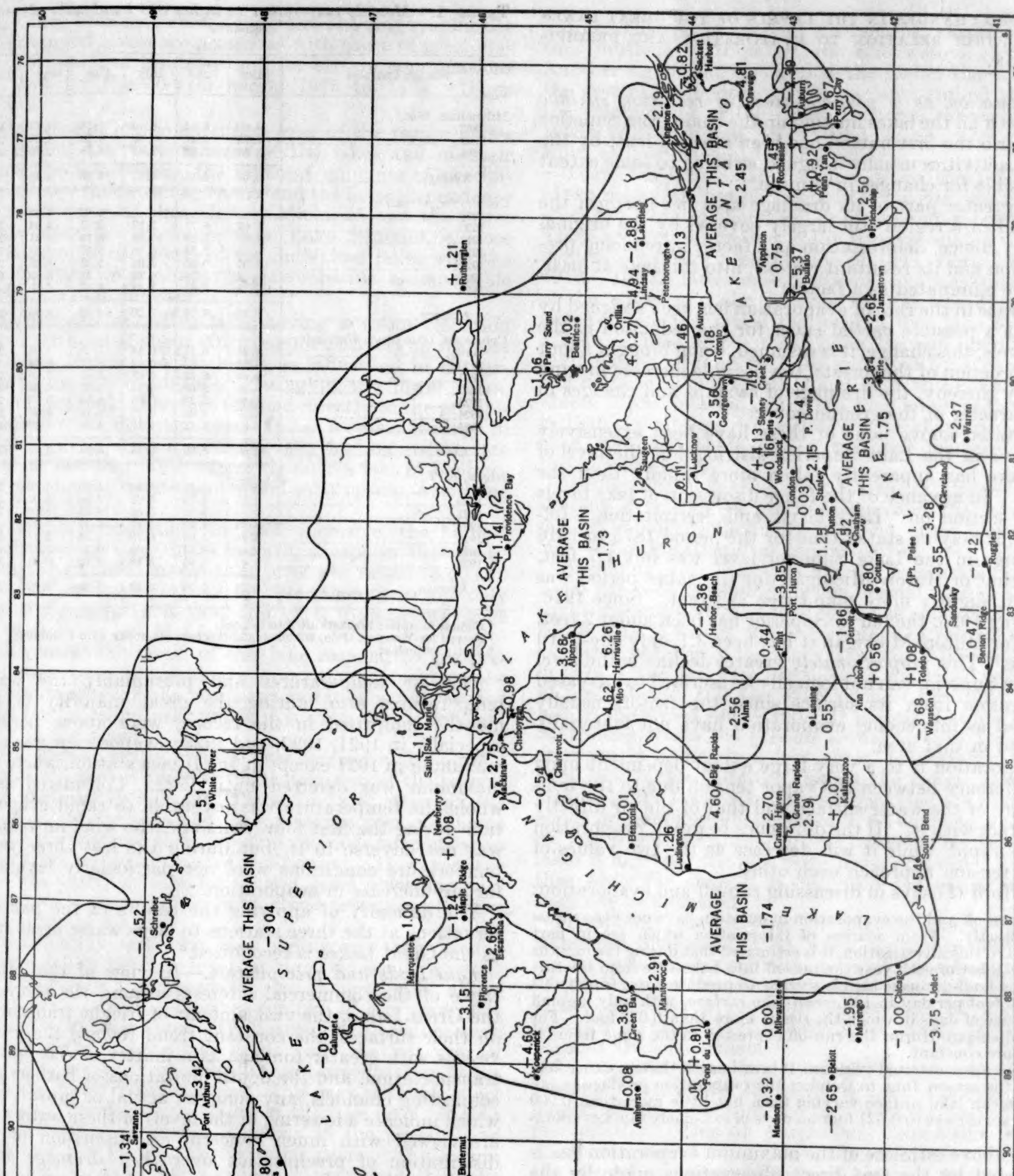

FIG. 8.—Mean annual departures of precipitation over the Great Lakes region for the 8-year period 1917–1924, inclusive, from the 50-year normal

RECORDED CHANGES IN THE LEVELS OF THE GREAT LAKES AND THEIR RELATION TO EVAPORATION AND PRECIPITATION.

Evaporation as a possible cause of reduction in lake levels.—Of all the lakes making up the chain from Superior to Ontario the first named has been affected least by the human activities usually assigned as being to some extent responsible for changes in climate.

The greater part of its drainage area lies north of the lake and in a region still largely covered by the original forest. Hence, deforestation as a factor in reducing precipitation and its resultant run-off, into this lake at least, must be eliminated as a factor.

Increase in the rate of evaporation has been assigned by some as a possible partial cause for the reduction in the lake levels, this change, it is assumed, being brought about by destruction of the forests, the possible increase in wind velocity thereby, the drainage of swamps and changes in the character of the ground cover.

As stated above none of these have been extensively operative in the Lake Superior district, but the level of that lake has apparently fallen more rapidly than the others. In advance of the fuller discussion of lake levels in the section on "Lake levels and precipitation," following, it may be stated that for the period 1875 to 1916 the range in the Lake Superior level was but 1.7 feet, while that of Huron–Michigan for the same period was 3.6 feet, slightly more than twice as great. Since 1916, including 1925, the fall in Superior has been about 2 feet, while for Huron–Michigan it has been 3.1, only one-third greater. This *proportionately* greater decline in the level of Lake Superior can not logically be ascribed to increased evaporation from its surface since the factors usually assigned as influencing evaporation have not materially changed in that area.

Evaporation is to a very large extent dependent upon the difference between the vapor tension due to the temperature of the water surface and that of the air directly in contact with it. If the difference be great, evaporation will be rapid, while it will decrease as the two values of vapor tension approach each other.

Hayford (*2*) says in discussing run-off and evaporation:

> The run-off and the evaporation in question have not been measured directly. From sources of information which are in part external to this investigation, it is estimated that during the months June–October of each year the run-off into Lake Erie from the surrounding land-drainage area is such as to produce a rise from 0.004 to 0.040 foot per day in the mean lake surface, with only a small percentage of days in which the rise is more than 0.020 foot. For Lake Michigan–Huron the run-off expressed in the same terms is even more constant.
>
> So, too, from external evidence, it is estimated that on either lake during the season June to October the evaporation produces a fall in the mean lake surface varying from but little more than 0.000 foot on some days to 0.021 foot on days of extremely rapid evaporation. * * *

The above estimate of the maximum evaporation loss is supported by the few direct observations made by the United States engineers at Milwaukee (*3*) in 1862–64 as given in Table No. 1 below. That table also includes the monthly totals of evaporation as recorded at the three evaporation stations maintained by the Weather Bureau in the general region of the Great Lakes, but not, however, close to any one of them. These stations are located at Centerville, Minn., Columbus, Ohio, and Ithaca, N. Y., and the record is for the months May–September, both inclusive, 1919–1925.

TABLE 1.—*Monthly evaporation in inches and hundredths at certain stations*

Station and year	May	June	July	Aug.	Sept.	Total
Milwaukee, Wis.:						
1862	4.90	5.54	6.49	5.76	4.13	26.82
1863	3.75	5.41	5.18	4.73	4.00	23.07
1864	8.36	7.53	7.45	4.78	2.00	30.12
Average	5.67	6.16	6.37	5.09	3.38	26.67
Centerville, Minn.:						
1919	------	------	------	6.62	4.51	------
1920	6.07	5.71	7.17	6.07	4.64	29.66
1921	5.61	7.29	10.68	6.19	4.37	34.14
1922	5.75	7.56	6.20	5.87	4.23	29.61
1923	7.01	6.56	7.06	5.33	4.39	30.35
1924	6.38	5.74	6.14	7.25	3.36	28.87
1925	[1] [7.26]	7.67	5.92	8.37	5.69	[1] [34.91]
Average	6.35	6.76	7.20	6.53	4.46	31.26
Columbus, Ohio (State University):						
1919	3.45	6.11	[2] 6.84	5.40	4.25	26.05
1920	4.87	5.12	6.02	3.58	3.63	23.22
1921	4.89	6.42	6.68	5.85	3.40	27.24
1922	4.69	5.69	6.12	4.91	4.02	25.43
1923	4.56	5.26	5.68	4.34	3.42	23.26
1924	3.17	4.05	5.78	5.76	3.38	22.14
1925	[3] 5.83	7.12	5.77	4.94	4.32	27.98
Average	4.49	5.68	6.13	4.97	3.77	25.05
Ithaca, N. Y.:						
1919	3.70	5.11	5.60	4.00	3.74	22.15
1920	4.93	4.78	5.02	4.45	4.07	23.25
1921	4.58	5.90	5.58	5.33	4.10	25.49
1922	4.74	4.95	5.81	5.11	7.05	27.66
1923	4.24	5.06	5.75	4.85	2.37	22.27
1924	2.65	4.53	5.04	4.28	2.31	18.81
1925	3.42	6.05	5.14	4.12	2.43	21.16
Average	4.04	5.20	5.42	4.59	3.72	22.97

[1] Figures in square brackets are interpolated.
[2] Record for Wooster, Ohio, which should compare favorably with Columbus.
[3] Partly estimated.

The air temperatures and presumably the water temperatures also, during the great majority of the months comprised in the record, were above normal, especially in 1921, 1922, and 1923; evaporation was at a maximum in 1921 except at the Ithaca station, where the maximum was deferred until 1922. Considered as a whole the temperature was favorable to rapid evaporation during the first four years and the wind movement was not adverse to it, but during the last three years temperature conditions were not particularly favorable for any increase in evaporation.

The difficulty of applying the results of the pan observations at the three stations to large water areas such as the Great Lakes is recognized.[3]

Lake levels and precipitation.—In view of the importance of the commercial interests around the shores of the Great Lakes, the vast amount of freight transported on their surfaces, the constant trend toward the use of vessels with greater tonnage as a matter of economy in transportation, and the depth limitations of harbors and connecting channels, any changes, actual or prospective, which indicate a lowering of the levels of these waterways are viewed with much concern. A discussion of the distribution of precipitation over their drainage areas would be incomplete without some comparison of this with their stages.

Through the courtesy of the United States Lake Survey Office, Detroit, Mich., transcripts of the monthly and annual levels of the several lakes from about 1860 to

[3] An extensive and interesting discussion of the possibilities of evaporation from the Great Lakes is now in course of preparation by Mr. John R. Freeman, consulting engineer, Providence, R. I., in which the problem is approached by several different methods, but mainly by measurements of differences between the inflow into the lakes and the discharge therefrom, and by consideration of the temperature, wind and other conditions over their surfaces, based upon many years of observation.

1924 have been secured and diagrams showing graphically these annual levels are presented with those of precipitation, for each of the lakes and for certain combinations of these for the 50-year period 1875 to 1924. (Figs. 7, 8, 9.)

On account of the extensive area of the region under discussion, the various sizes of the lakes and of their respective watersheds, the different amounts of precipitation over their drainage areas and the large dependence of the levels of Lakes Huron, Michigan and the lower chain upon the discharge from Lake Superior, a close correlation of the levels of the individual lakes with the precipitation over their respective basins is impossible save for Lake Superior.

Lake Superior.—This lake, having a mean elevation above sea level of about 602.2 feet, or 21.3 feet above that of Lakes Huron and Michigan, is influenced in no particular by the conditions existing in the lower lakes. Its stages should therefore respond directly to the precipitation over its drainage area. It has a seasonal range in level of about 1 foot, being usually highest in the late summer and early fall, averaging 602.78 feet in September, and lowest in late winter and early spring, averaging 601.75 in March.

For the period, 1860 to 1924, inclusive, the highest yearly average was 603.06 in 1876, except in 1916 when partly by artificial means [4] the level was raised to 603.10 feet, and the lowest 601.42 in 1924, though it was only a trifle higher in 1879, 1892 and 1911, the extreme range by years being but 1.64 feet.

In general the levels of this lake respond to the precipitation over the drainage area, though usually the maximum effect of one year's precipitation is not reached until the following year unless it is excessive or deficient early in the season.

The highest yearly average ever reached under normal conditions, that is prior to the installation of the regulatory works in 1916, is 603.06 feet in 1876, although the precipitation for that and the preceding year, as shown by the few stations then in operation, does not appear to have been materially above the normal. However, the lake was nearly as high for several years preceding, and the excess of precipitation in 1876 was promptly effective in continuing the rise.

Immediately following this high stage there was a marked fall in the lake level for three consecutive years, during which the precipitation, though still above normal, diminished somewhat for two of the years, but not in the volume apparently necessary to produce such a large change in the lake level, while the last year of the three had apparently the heaviest precipitation of the 50 years under consideraton. This was without effect in staying the downward trend of the lake level for that year, though its influence is shown in the prompt and important rise in the two following years. The failure of the heavy precipitation in 1879 to stay the fall in lake level for that year was doubtless in a measure due to its occurrence mainly late in the season. Also it is possible the interpolated values of precipitation, assigning heavy falls to the entire drainage area, as indicated by the few records available at that time, may have been in error. Furthermore, there is some evidence of error in the measurements of lake levels, as shown by unusual changes in some of the months, and to the fact that portions of these records also were interpolated. Another significant fact is that the higher the lake level the greater the opportunity for a rapid run-off through the enlargement of the usual discharge channels. The levels will therefore be lowered much more rapidly when at flood than at lower stages.

There are occasional instances when the full extent of the rise or fall, but particularly of the rise, is coincident with the year of increased or decreased precipitation. These are well illustrated in the rises associated with the moderately heavy precipitation of 1893, 1894, 1899 and 1916. In the latter case, however, compensating works at the outlet of Lake Superior had, as already pointed out, permanently raised the level of that lake by about 1 foot. These works must have become operative to some extent prior to 1916, as indicated by a rise of 1.7 feet in the level between 1911 and 1916, without any large excess of precipitation, while the completion of the works in 1916 is doubtless responsible for the sharp rise in that year, although there was a material increase in the precipitation also.

During the following year, however, there was a striking deficiency in precipitation, and the lake level fell off rapidly, apparently from no other cause than lack of precipitation over the watershed.

Beginning with 1917, the annual precipitation in this basin has been constantly below normal, and except for slight interruptions, the lake level has continued to fall, till in 1924 it was at the lowest stage of record, though as stated previously the stage was only 0.01 foot higher in 1879. The past year has shown a continued deficiency in precipitation and the average level for 1925, 601.10 feet, is the lowest since 1860. It is clear that but for the controlling works the present actual level of Lake Superior would be nearly a foot lower, presumably all due to a lack of precipitation, unless the canals and locks leading to the lower lakes have augmented the discharge, which appears improbable since in all operations tending to improve navigation in the links connecting these lakes it has been the aim to so place excavated material that while the channel is deepened the actual outflow shall not be increased.

Examining the records of precipitation over the watershed since about 1885, when the number of reporting stations became sufficient to establish reliable values of precipitation for all portions of the drainage area, it appears that a precipitation average of about 29 inches will maintain the lake level above 602.2 feet, without artificial control.

In comparing the changes in Lake Superior levels with the precipitation over its drainage area, it is remarkable how small the responses are to important variations in precipitation. This is particularly noticeable in the great extremes of precipitation in 1884 and 1885, when the annual averages differed by about 1 foot, but the increase in lake level from 1884, the year of excessive precipitation, to 1885 was only 0.3 foot, while the decrease from 1885, the year of marked deficiency, to 1886 was but 0.4 foot. This may have been due largely to the season of the year in which the bulk of the precipitation occurred. In this case the excessive precipitation of 1884 was largely toward the latter part of the season and did not become fully effective until the following year, thereby overcoming to some extent the effects of the deficiency in 1885.

[4] Letter under date May 18, 1925, from Lieut. Col. E. J. Dent, Corps of Engineers U. S. A., reports that compensating works at the outlet of Lake Superior had permanently raised the level of that lake by about 1 foot.

Lakes Huron and Michigan.—As these lakes stand at practically the same elevation (average for the 50-year period, 580.9 feet above sea level), and their drainage areas receive usually similar amounts of precipitation, conditions affecting the level of one will be reflected promptly in the other, and they may be considered as a single lake.

Like Superior, they were at high stages near the beginning of the period, the level in 1876, 582.61 feet, being within a few inches of that in 1886, 582.96 feet, the highest in the 50-year period. The levels of these lakes also fell off rapidly, as did Superior, during the three years following 1876, due to diminishing precipitation, but the fall was somewhat less rapid than was that of low stages of Lake Superior, whose drainage area during a portion of the period was likewise experiencing an important reduction in precipitation with diminishing run-off.

There was a sharp fall of slightly more than 1 foot in the levels of Lakes Huron and Michigan from 1894 to 1895, the drought years, the greatest change within 1 year for the entire 50 years, and a continued slight fall in 1896 brought the level of Lake Michigan to an elevation of 579.47 feet, 3.49 feet lower than in 1886, as quoted from the report of the Deep Waterways Commission noted above, and within 0.41 foot of the stage of 1924, 579.06 feet, the lowest of record for the 50-year period. The 1925 stage was only 578.21 or 0.85 foot lower still.

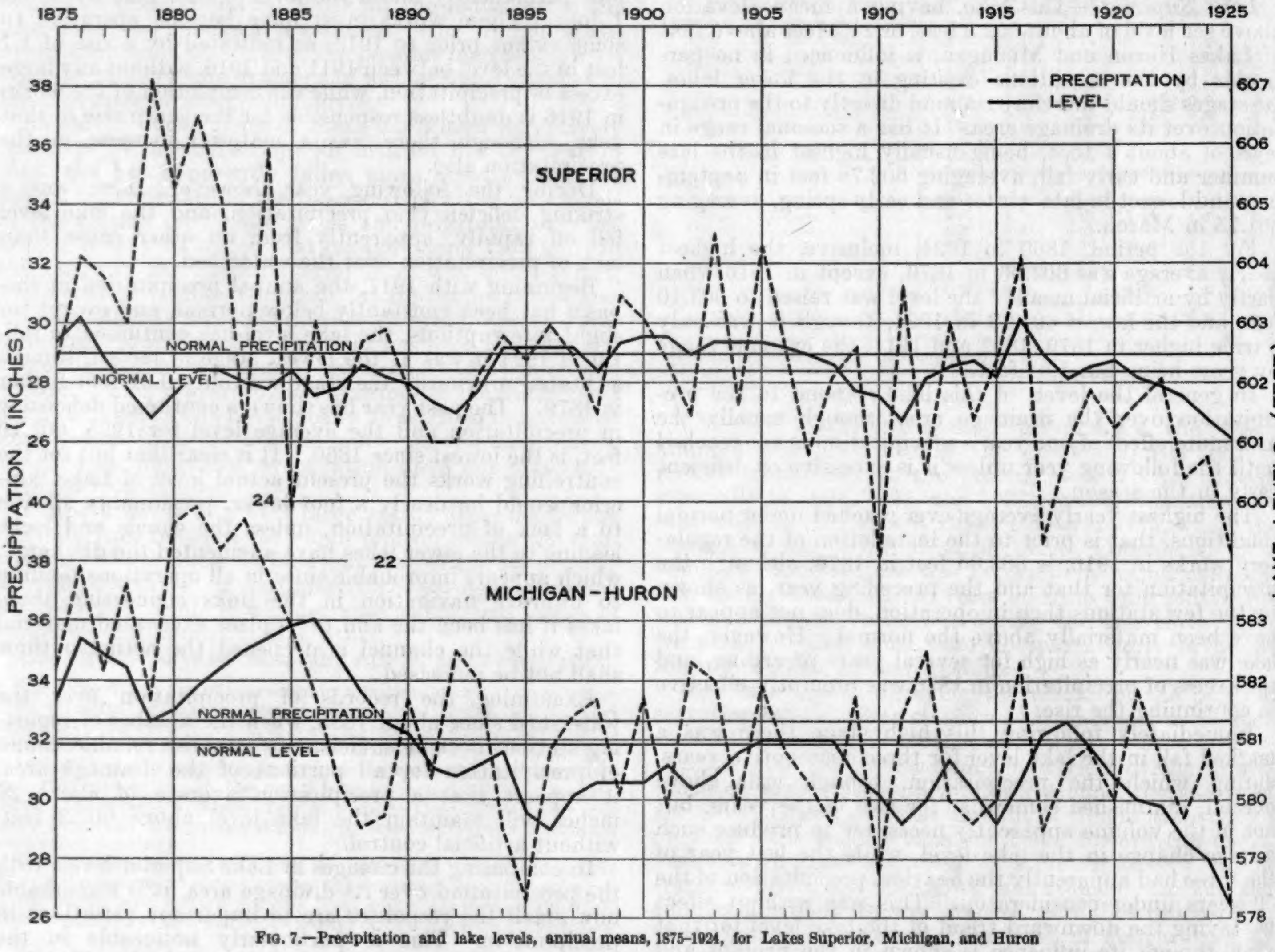

FIG. 7.—Precipitation and lake levels, annual means, 1875-1924, for Lakes Superior, Michigan, and Huron

Superior, probably on account of continued excessive discharge from that lake.

Under the influence of much the heaviest precipitation in the 50 years over the drainage basins of these lakes, from 1880 to 1885, supplemented by a nearly normal discharge from Lake Superior, they again rose steadily to a level of 582.96 feet by 1886, the highest, as previously stated, in the 50-year period and probably with one or two exceptions the highest since 1838, the year of maximum known stage, 584.34 feet.

Beginning in 1886 there was a sharp decrease in precipitation, which, with slight recoveries in 1890, 1892 and 1893, continued until 1895, inclusive, the last-named year having the least of the 50 years. The lake levels fell off during this period, the decline being augmented by the

With increasing precipitation over the basins during the 8 to 10 years following 1895, augmented by more than normal discharge from Lake Superior due to the same cause, the levels of these lakes gradually rose to slightly above normal stage of 580.90 feet, continuing steadily at 581 feet thereafter for several years.

Since 1908 there have been several sharp increases and decreases due to changing precipitation in both the Huron-Michigan and Superior basins and to increasing or decreasing discharge from Lake Superior, the lakes rising in 1918 to the highest point since 1889.

Since 1916, excepting 1921, the precipitation in the basin of these two lakes, as well as that of Lake Superior during the whole period, has been constantly below normal, the average deficiency for the 8-year period

being 1.7 inches per year, or a total of 13.6 inches for the period. During the 9 years, 1893 to 1901, inclusive, the average precipitation was slightly less in this basin than indicated above, but in this period Lake Superior levels were high and the discharge probably was materially above normal, thus offsetting the effect of decreased precipitation in the Huron-Michigan basin.

Since 1916, precipitation over the Lake Superior basin has been constantly below normal, the average yearly deficiency being 2.84 inches or a total of nearly 23 inches for the 8-year period. As a result, the water level of Lake Superior has been greatly reduced, despite the presence of regulatory works at the Soo, and Lakes Huron and Michigan are now receiving far less discharge from Superior than usual.

The prompt rise of these lakes in 1917 and 1918 in response to the moderately heavy precipitation over their drainage areas in 1916, with nearly normal discharge from Lake Superior, shows that with an average annual precipitation of slightly more than 32 inches, the normal for the basin, and with the usual discharge from Lake Superior, these lakes will maintain their normal level.

In connection with the 1924 levels of these lakes, it is interesting to note that in their early history they showed fluctuation as great or possibly greater than any in recent years.

The report of the Board of Engineers on Deep Waterways (*4*), gives numerous references to the early levels of the Great Lakes, and shows that the extreme high water to which all levels concerning Lake Michigan are referred, occurred in 1838, when the elevation stood at 584.3 feet, 3.4 feet above the normal. It was nearly as high in 1858–1859.

The lowest authentic stage appears to have occurred in 1819, 577.7 feet, 6.6 feet lower than in 1838 and 0.5 foot lower than in 1925, which, with that exception, is probably the lowest of record.

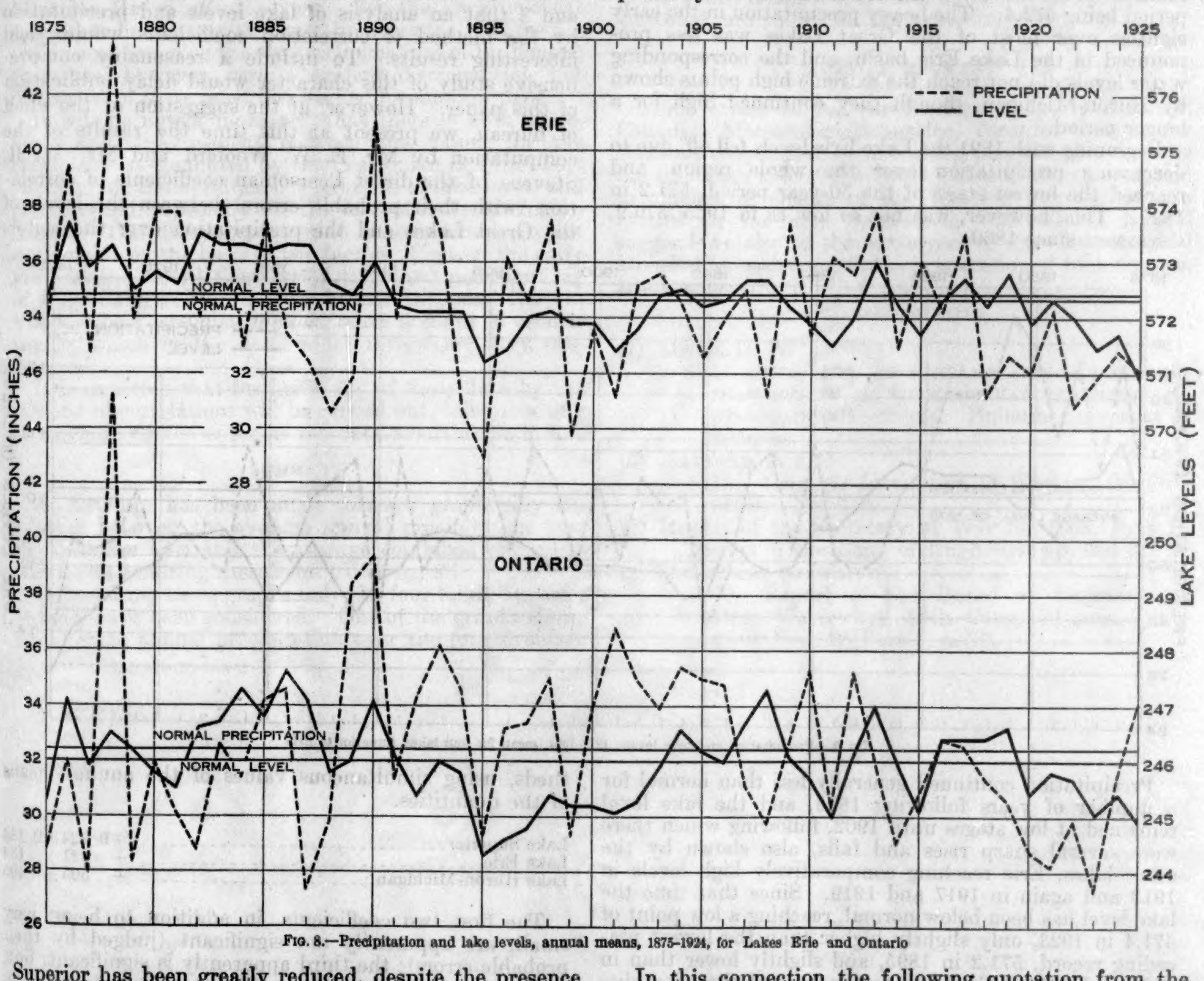

FIG. 8.—Precipitation and lake levels, annual means, 1875-1924, for Lakes Erie and Ontario

In this connection the following quotation from the report of the Board of Engineers on Deep Waterways is pertinent (*4*):

> The general depth of the foot of Lake Huron, 1½ miles above the head of the St. Clair River, was originally about 21 feet to 27 feet, over which were scattered numerous shoals with only 16 to 18 feet of water. A channel 2,400 feet wide and 21 feet deep at mean stage has been cut through these shoals. At the time of the last complete survey of the head of the river, in 1867, the depth across the bar over which the lake discharges into the St. Clair River was only 27 feet, and through the gorge at the head of the river the central depth was 48 feet.
>
> Investigations made during 1898 and 1899 show that a channel has been scoured through the bar 75 feet deep, and the depth in the gorge at the narrowest place increased from 48 feet to 66 feet.
>
> There is now a channel over 40 feet deep from the lake into the river, the increased outflow through which has lowered the general level of Lakes Huron and Michigan about 1 foot.

Lake Erie.—On account of the smaller area of the drainage basin, and its lower elevation, the levels of this lake are governed largely by the discharge from the higher lakes of the chain.

In general, the responses to variations in precipitation are more prompt here than in the larger lakes, though, as might be expected, they are less in degree, due to the steadying effects of the discharge from the other lakes.

Like the lakes previously discussed, Erie was at high stages near the beginning of the period, reaching a maximum in 1876 of 573.7 feet, the normal for the 50-year period being 572.4. The heavy precipitation in the early eighties over most of the Great Lakes was less pronounced in the Lake Erie basin, and the corresponding water levels did not reach the extreme high points shown by Huron-Michigan, though they continued high for a longer period.

Beginning with 1891 the Lake Erie levels fell off, due to decreasing precipitation over the whole region, and reached the lowest stage of the 50-year period, 571.2 in 1895. This, however, was not so low as in 1925, 570.9, the lowest since 1860.

With the other lakes, Ontario has been more or less below its usual level for several years, though the fall has not been so uniform or so extreme. Like Erie it rose slightly during 1924, following a considerable increase in precipitation over its basin, but fell with the other lakes in 1925, despite a continued increase in the precipitation over the drainage area, though in 1925 it did not reach the low average level of 1895 by more than half a foot.

Mathematical correlations between precipitation and lake levels.—It seems clear from an inspection of Figures 7 and 8 that an analysis of lake levels and precipitation by the method of correlation coefficients would yield interesting results. To include a reasonably comprehensive study of this character would delay publication of this paper. However, at the suggestion of the chief of bureau, we present at this time the results of the computation by Mr. E. W. Woolard and Mr. W. R. Stevens of the direct Pearsonian coefficients of correlation (with their probable errors) between the levels of the Great Lakes and the precipitation over the water-

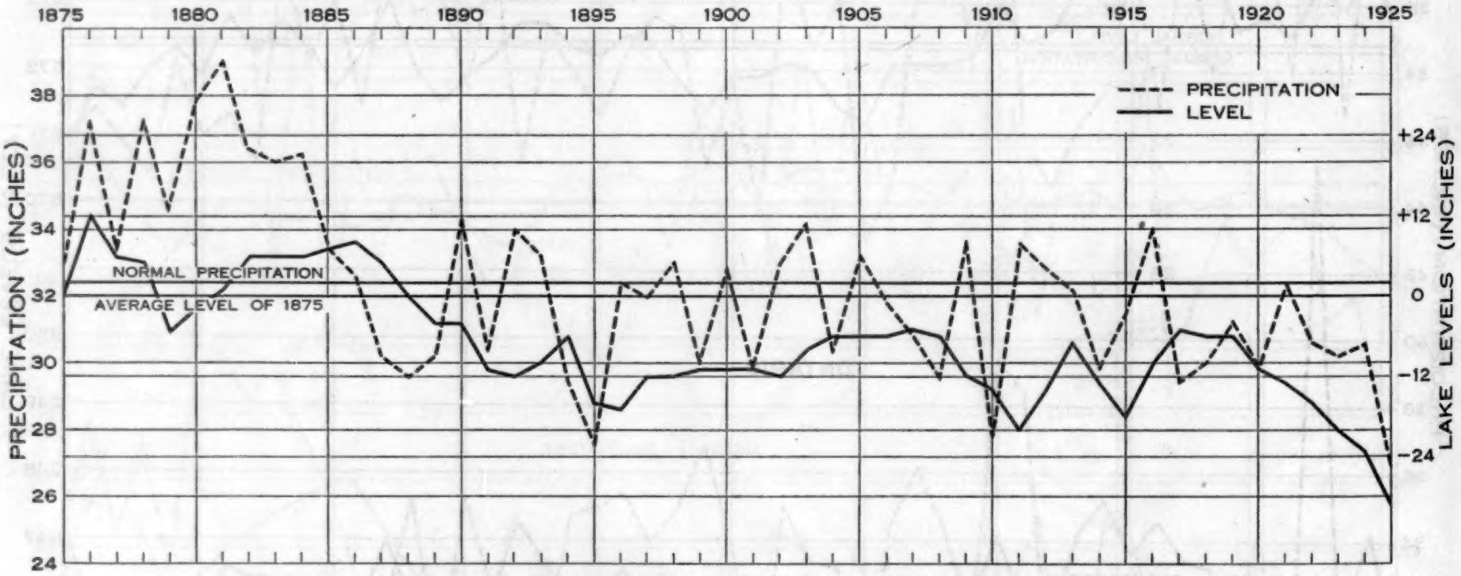

FIG. 9.—Precipitation and lake levels, 1875-1924, mean for four lakes, Superior to Erie

Precipitation continued generally less than normal for a number of years following 1895, and the lake level remained at low stages until 1902, following which there were several sharp rises and falls, also shown by the other lakes, Erie reaching comparatively high levels in 1913 and again in 1917 and 1919. Since that time the lake level has been below normal, reaching a low point of 571.4 in 1923, only slightly higher than the lowest preceding record, 571.2 in 1895, and slightly lower than in 1901 and 1911. Contrary to the case of the lakes discussed previously, Lake Erie showed a slight rise from 1923 to 1924, due evidently to increased precipitation over its watershed; but, as stated above, its stage again fell during 1925.

Lake Ontario.—This lake has an average elevation of 246 feet above sea level, or 326.4 feet lower than Lake Erie. It has generally wider fluctuations than Erie, but they are mainly similar.

Like the other lakes it was high in 1876, but reached its peak in 1886, 247.6 feet, though it was nearly as high in 1908 and again in 1913. As in the case of Erie it reached its lowest level for the 50-year period, 244.8 feet, in 1895.

sheds, using simultaneous values of the annual means of the quantities.

Lake Superior	+0. 224±0. 134
Lake Erie	+ . 221± . 134
Lake Huron-Michigan	+ . 505± . 105

The first two coefficients, in addition to being very small, are apparently not significant (judged by their probable errors); the third apparently is significant, but, since the importance of a coefficient is measured by its square, even this coefficient is not very large. Moreover, the ordinary formula for the probable error of a correlation coefficient is not reliable for samples as small as 50.

There is, of course, a delay in the response of lake levels to precipitation. Mr. H. W. Clough has sought to bring this out by his short method of obtaining correlation coefficients, which is based on the signs of year-to-year variations. The following table shows the coefficients between precipitation and lake levels, the precipitation being compared with the lake levels of one year before, of the same year, and of one, two, and three years later:

	−1	0	+1	+2	+3
Superior	−38	+20	+55	−50	−57
Michigan-Huron	−48	−28	+52	+36	+15
Erie	−56	+57	−25	+20	−57
Ontario	−48	+40	−32	−29	+33

The sequence of the signs and the magnitude of the values clearly indicates a lag of lake levels behind precipitation, but accurate evaluation of this lag from yearly data is impossible. For Superior, the lag is apparently somewhat less than a year (about nine months) and for Michigan-Huron about a year. For the lower lakes it appears to be between two and three months. These are conclusions based on the obvious indications of the figures; there are, however, certain evident discrepancies, but discussion of these must be reserved for another paper.

It will be noted, moreover, that there is both agreement and disagreement between the values for the coefficients as computed by the Pearsonian and the short methods for the simultaneous relations of lake levels and precipitation, especially for the case of Lake Michigan-Huron. The disagreement is to a considerable extent explainable on the basis of two factors: First, in the early years of the record there was a large and persistent lag of the Michigan-Huron level behind the precipitation; second, the Pearsonian method takes account of secular trends, which in the data under review are very pronounced.

It is expected that further study of these data by the method of correlations will be carried out, using monthly or seasonal values as far as the data available permit.

SUMMARY

An attempt has been made to show graphically the relation between the average annual precipitation over the drainage area and the average combined change in lake levels resulting therefrom. (See fig. 8.)

In preparing these graphs only the four lakes, Superior to Erie, have been considered. One of the graphs shows the average annual precipitation over the four drainage areas, based on the records from all the stations used in computing the precipitation over these areas, while the other shows the average annual change in the levels of the four lakes resulting from changes in precipitation or other factors affecting their levels.

These, as may be expected, show decidedly complicated conditions, but still indicate that material variations in precipitation are effective on the lake levels for a considerably longer period than would be expected, thus making the combined changes comparatively small even when the changes in precipitation were large.

The yearly changes of the individual lakes, as previously indicated, are shown on the preceding diagrams.

ACKNOWLEDGMENT

Much credit is due Sir Frederic Stupart, Director, Canadian Meteorological Service, Toronto, Ontario, for generous cooperation in furnishing precipitation data for the Canadian side of the Great Lakes drainage area, and to officials in charge of the Weather Bureau stations located in the area considered, who offered helpful suggestions, also to the employees of the Climatological Division for assistance in the preparation of tables, maps, and graphs.

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(4) SECRETARY OF WAR.
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TABLE 2.—*Annual precipitation in the drainage area of Lake Superior, 1875–1924 (inches)*

	Duluth, Minn.	Grand Marais (near), Minn.	International Falls (near), Minn.	Pokegama Falls (near), Minn.	Sandy Lake Dam (near), Minn.	Virginia (near), Minn.	Ashland (near), Wis.	Butternut (near), Wis.	Florence (near), Wis.	Calumet, Mich.	Maple Ridge (near), Mich.	Marquette, Mich.	Newberry (near), Mich.	Sault Ste. Marie, Mich.	Port Arthur, Ont.	Savanne (near), Ont.	Schreiber (near), Ont.	White River, Ont.	Means
1875	27.03	[1] 25.34	[1] 24.62	[1] 25.68	[1] 25.95	[1] 27.84	[1] 27.22	[1] 31.33	[1] 37.36	[1] 31.90	[1] 39.49	30.22	[1] 35.15	29.66	[1] 22.16	[1] 24.15	[1] 29.10	[1] 24.56	28.82
1876	32.27	[1] 30.25	[1] 29.40	[1] 30.66	[1] 30.98	[1] 33.24	[1] 31.17	[1] 35.08	[1] 37.10	[1] 35.72	[1] 39.48	31.44	[1] 35.16	32.41	[1] 26.46	[1] 28.84	[1] 33.66	[1] 27.46	32.27
1877	34.31	[1] 32.36	[1] 31.25	[1] 32.59	[1] 32.94	[1] 35.34	[1] 31.45	[1] 34.36	[1] 31.28	[1] 34.98	[1] 33.15	27.54	[1] 29.52	27.09	[1] 28.58	[1] 30.66	[1] 34.86	[1] 26.84	31.63
1878	28.09	[1] 26.98	[1] 26.38	[1] 26.68	[1] 26.97	[1] 28.93	[1] 29.66	[1] 34.95	[1] 34.36	[1] 35.59	[1] 36.42	36.19	[1] 32.48	25.19	24.48	[1] 26.68	[1] 32.80	[1] 28.24	30.06
1879	45.28	[1] 38.10	[1] 35.91	[1] 43.02	[1] 43.47	[1] 46.64	[1] 42.77	[1] 47.54	[1] 35.50	[1] 48.40	[1] 37.60	40.75	[1] 33.56	23.09	27.42	[1] 29.89	[1] 36.78	[1] 31.72	38.19
1880	38.05	[1] 34.94	[1] 33.78	[1] 36.15	[1] 36.53	[1] 39.19	[1] 35.71	[1] 39.55	[1] 31.77	[1] 40.26	[1] 33.62	33.44	[1] 29.98	30.62	29.58	[1] 32.06	[1] 37.23	[1] 30.02	34.58
1881	37.55	[1] 33.33	[1] 31.92	[1] 35.67	[1] 36.05	[1] 38.68	[1] 38.09	[1] 43.98	[1] 40.98	[1] 44.79	[1] 48.61	42.91	[1] 43.31	24.92	26.63	[1] 29.03	[1] 36.50	[1] 32.14	36.95
1882	38.02	[1] 31.24	[1] 29.23	[1] 36.12	[1] 36.50	[1] 39.16	[1] 36.73	[1] 41.35	[1] 38.75	[1] 42.10	[1] 40.98	37.08	[1] 36.52	31.03	21.35	[1] 23.27	[1] 29.89	[1] 26.84	34.23
1883	23.20	[1] 23.42	[1] 23.18	[1] 22.04	[1] 22.27	[1] 23.90	[1] 24.68	[1] 29.17	[1] 30.20	[1] 29.70	[1] 31.56	30.50	[1] 28.58	31.20	22.75	[1] 24.80	[1] 29.75	[1] 25.00	26.44
1884	35.35	[1] 31.70	[1] 30.44	[1] 33.58	[1] 33.94	[1] 36.41	[1] 36.15	[1] 41.93	[1] 42.24	[1] 42.70	[1] 44.88	41.44	40.43	31.42	25.78	[1] 28.10	[1] 35.32	[1] 31.08	35.72
1885	19.96	[1] 19.82	[1] 19.54	[1] 18.96	[1] 19.16	[1] 20.56	[1] 21.91	[1] 26.28	[1] 29.82	[1] 26.76	[1] 31.90	28.60	30.90	27.53	18.84	[1] 20.54	[1] 25.42	[1] 22.04	23.81
1886	33.37	[1] 29.45	[1] 28.16	[1] 31.70	[1] 32.04	[1] 34.37	[1] 31.30	[1] 34.66	[1] 30.98	[1] 35.28	[1] 32.76	29.27	29.12	31.29	23.28	18.11	[1] 29.98	24.80	30.00
1887	28.56	[1] 27.69	[1] 27.16	28.18	[1] 27.42	[1] 29.42	[1] 26.96	[1] 29.94	[1] 24.25	[1] 30.48	[1] 25.70	25.62	21.72	23.16	25.48	22.80	30.22	[1] 22.69	26.52
1888	27.31	[1] 27.37	[1] 27.06	27.13	[1] 26.22	[1] 28.13	[1] 28.92	[1] 34.12	[1] 30.44	23.59	35.48	35.46	31.24	38.41	26.36	25.50	32.00	[1] 24.72	29.41
1889	32.04	[1] 29.24	28.00	25.65	27.00	30.00	30.50	30.00	[1] 28.45	31.19	28.38	30.31	30.90	35.39	24.50	26.54	[1] 35.68	33.18	29.83
1890	24.09	[1] 22.77	22.00	26.63	24.50	23.00	26.00	35.02	[1] 32.14	27.37	34.14	34.47	35.10	40.06	20.17	19.43	[1] 28.17	25.24	27.79
1891	29.47	[1] 25.99	21.00	26.00	23.00	22.50	28.36	26.04	[1] 29.08	24.74	25.33	33.78	30.27	29.57	20.52	30.59	[1] 23.64	17.07	25.94
1892	28.52	[1] 24.82	28.74	22.59	22.43	27.00	26.26	24.91	32.22	27.99	31.43	27.28	29.60	30.09	19.12	25.79	[1] 22.77	17.19	26.04
1893	23.34	[1] 23.67	29.26	26.24	23.67	26.00	28.68	31.10	32.00	25.98	32.24	35.86	33.45	39.64	23.15	22.20	27.66	28.12	28.46
1894	31.70	[1] 28.18	24.66	32.01	20.11	34.73	33.25	26.11	27.56	32.42	29.02	35.58	33.87	38.53	22.52	28.00	30.85	23.88	29.61
1895	22.30	24.62	23.93	26.53	21.70	36.10	30.36	34.89	27.29	36.82	31.11	33.04	30.59	30.55	22.47	28.71	[1] 30.20	26.08	28.74
1896	27.19	32.14	25.00	32.58	34.57	39.47	23.81	27.40	29.47	34.72	33.00	29.59	32.25	34.62	21.50	25.41	[1] 29.73	26.40	29.94
1897	30.94	32.07	25.53	28.24	34.01	30.59	30.32	35.38	27.28	28.64	26.95	30.03	29.53	36.16	24.51	26.30	[1] 26.60	17.58	28.93
1898	19.70	31.80	27.97	27.55	22.06	30.54	18.60	21.76	27.49	34.96	32.63	27.48	25.11	27.91	28.14	34.10	23.16	26.85	27.10
1899	30.62	30.00	29.00	37.23	33.46	35.39	30.12	35.74	32.63	39.28	30.87	36.43	21.82	30.68	26.53	19.44	[1] 32.73	25.79	30.99
1900	23.14	30.20	29.50	29.35	20.97	31.50	27.99	38.22	37.83	40.62	33.47	32.32	18.35	30.93	27.09	[1] 29.53	[1] 34.22	27.70	30.16
1901	26.68	25.07	26.00	29.64	21.50	30.15	31.81	28.71	32.71	31.31	45.90	37.19	18.66	27.38	22.51	[1] 24.54	[1] 30.92	27.28	28.78
1902	26.14	27.72	22.00	27.13	28.20	31.13	26.24	28.52	27.26	34.99	28.10	26.77	17.90	26.00	21.82	26.60	[1] 31.16	28.49	27.01
1903	28.01	30.00	30.00	29.77	35.36	33.90	35.69	46.68	43.27	38.51	38.00	39.84	28.21	29.04	22.11	22.87	[1] 31.92	29.46	32.92
1904	24.45	23.75	25.00	22.66	20.86	27.02	26.98	31.30	29.43	32.47	32.00	33.24	31.72	27.50	22.27	25.65	[1] 30.84	27.42	27.48
1905	35.77	32.67	35.00	37.76	36.16	42.83	33.63	41.00	32.51	35.41	32.50	28.18	26.79	25.81	26.11	26.85	[1] 32.43	25.76	32.62
1906	28.78	24.36	26.00	26.67	27.26	29.17	33.14	33.46	40.23	34.56	31.47	37.49	22.19	23.71	25.08	[1] 27.34	[1] 30.14	23.01	29.11
1907	23.87	23.60	21.00	20.97	21.91	20.59	20.82	24.98	23.02	30.68	29.46	31.62	26.50	24.42	23.89	[1] 26.04	[1] 35.36	33.31	25.67
1908	31.05	27.30	24.64	24.94	33.68	26.01	28.54	28.00	24.21	32.12	26.95	30.29	24.45	26.06	24.55	[1] 26.76	[1] 35.96	33.59	28.28
1909	33.65	27.00	29.19	24.73	29.73	32.06	34.64	29.50	35.84	33.47	31.56	29.27	29.32	24.54	20.98	[1] 22.87	[1] 30.12	27.67	29.23
1910	18.11	17.00	18.89	21.25	19.77	18.39	18.59	17.14	22.00	28.53	28.86	30.54	25.00	24.25	16.55	[1] 18.04	28.20	28.06	22.18
1911	30.30	27.60	26.61	28.55	21.96	26.31	28.89	29.69	36.78	34.64	41.55	37.22	29.35	29.08	24.93	[1] 27.17	46.09	35.37	31.23
1912	21.34	20.75	21.85	16.97	19.78	20.96	22.16	29.10	28.25	34.07	29.51	30.59	24.51	26.43	20.11	[1] 21.92	34.29	28.47	25.06
1913	28.69	27.64	27.91	32.43	27.57	29.36	29.65	35.59	31.16	30.63	29.74	30.24	30.26	30.49	26.97	[1] 29.40	40.24	20.59	29.92
1914	30.09	24.36	25.13	21.52	27.75	28.12	24.71	33.90	30.66	30.56	34.34	29.28	30.30	26.51	19.54	21.60	27.54	16.24	26.79
1915	25.77	25.60	24.00	26.24	27.73	25.56	23.87	34.45	35.05	34.77	32.93	35.24	33.73	28.43	25.43	17.20	34.29	26.25	28.70
1916	29.38	29.35	30.57	25.35	26.15	28.39	30.63	38.90	32.12	44.37	37.33	39.23	35.52	41.02	29.35	26.14	26.04	29.10	32.16
1917	23.23	24.00	15.12	15.14	20.98	18.88	25.84	28.16	19.08	29.38	27.86	27.29	26.59	23.48	14.93	20.60	23.82	24.36	22.71
1918	19.76	16.86	19.32	21.31	20.55	19.42	20.70	27.16	26.07	34.82	30.76	41.81	34.15	31.01	20.24	25.02	32.34	28.36	26.09
1919	23.77	17.99	29.55	26.17	27.25	28.62	27.30	36.76	25.15	33.81	35.51	28.54	28.53	29.39	18.14	21.09	31.32	30.49	27.74
1920	29.74	20.53	18.29	20.58	26.90	25.42	32.90	32.05	28.34	32.68	33.31	29.16	27.50	29.11	22.70	24.23	23.03	22.31	26.60
1921	25.07	22.50	20.62	20.85	25.24	21.19	25.31	38.55	32.62	26.95	32.67	31.28	32.52	31.64	22.83	27.73	25.98	24.71	27.35
1922	29.00	22.79	21.07	22.14	27.80	23.35	26.37	38.00	35.52	38.89	37.89	33.71	32.22	29.92	19.60	26.58	22.04	18.51	28.23
1923	22.29	21.77	16.93	15.75	21.83	17.80	22.13	28.84	30.25	34.09	32.33	25.35	29.15	28.38	17.59	23.18	26.02	20.95	24.73
1924	28.17	19.46	19.81	21.09	23.53	24.66	31.26	34.61	28.70	33.14	26.44	27.19	26.89	24.51	22.10	22.88	24.62	22.10	25.62
Means	28.29	26.54	25.74	26.97	27.15	29.16	28.78	32.92	31.37	33.84	33.34	32.54	29.61	29.59	23.19	25.25	30.67	26.11	28.97

[1] Interpolated.

TABLE 3.—*Annual precipitation in the drainage area of Lake Michigan, 1875–1924 (inches)*

	Amherst (near), Wis.	Beloit, Wis.	Florence, Wis.	Fond du Lac, Wis.	Green Bay, Wis.	Koepenick, Wis.	Madison, Wis.	Manitowoc, Wis.	Milwaukee, Wis.	Chicago, Ill.	Joliet (near), Ill.	Marengo, Ill.	South Bend (near), Ind.	Benzonia (near), Mich.	Big Rapids (near), Mich.	Charlevoix (near), Mich.	Escanaba, Mich.	Grand Haven, Mich.	Grand Rapids, Mich.	Kalamazoo, Mich.	Lansing, Mich.	Ludington (near), Mich.	Mackinaw City (near), Mich.	Means
1875	[1]28.46	37.44	[1]37.36	[1]25.96	[1]41.72	[1]40.06	22.80	30.26	35.56	38.06	36.52	34.68	36.20	42.90	35.00	37.63	43.54	34.41	33.67	31.00	28.44	[1]34.10	34.00	34.77
1876	[1]37.00	40.47	[1]37.10	[1]33.72	[1]46.81	[1]40.95	36.15	32.63	50.36	36.48	40.58	39.57	39.10	46.00	39.00	48.08	42.44	46.29	35.24	37.32	30.55	[1]40.84	36.00	39.68
1877	[1]30.01	40.81	[1]31.28	[1]27.36	[1]42.38	[1]33.90	27.67	28.16	46.15	41.01	34.34	34.47	44.05	35.00	34.99	33.95	34.61	36.03	31.83	47.78	37.42	[1]31.44	30.00	35.42
1878	[1]39.04	41.14	[1]34.36	[1]35.58	[1]37.26	[1]35.33	39.54	34.01	38.29	41.95	34.62	32.44	39.15	36.00	39.18	32.70	32.73	33.75	36.65	45.82	31.97	[1]30.84	29.00	36.15
1879	[1]33.12	35.70	[1]35.50	[1]30.63	[1]29.27	[1]31.23	35.21	27.22	24.93	30.71	29.62	32.61	45.00	38.00	34.95	39.56	30.76	35.48	29.91	39.21	26.72	[1]32.48	35.00	33.17
1880	[1]41.74	37.02	[1]31.77	[1]38.02	[1]31.58	[1]32.72	46.72	30.71	29.96	37.32	44.49	33.29	37.35	44.00	40.77	47.70	30.17	44.65	45.38	41.17	45.08	[1]39.24	34.00	38.47
881	[1]48.74	46.64	[1]40.98	[1]44.40	[1]46.02	[1]46.44	52.91	37.55	39.07	44.18	45.75	47.22	45.43	43.00	47.91	44.28	48.49	47.89	43.18	41.03	34.66	[1]40.28	36.00	44.00
1882	[1]44.64	38.02	[1]38.75	[1]40.70	[1]36.02	[1]43.12	42.89	40.13	28.43	41.34	43.03	35.36	41.31	45.30	34.36	42.62	40.07	42.16	41.73	33.70	32.88	[1]38.66	37.00	39.23
1883	[1]42.62	35.68	[1]30.20	[1]38.85	[1]31.24	[1]36.48	41.13	38.12	29.47	45.86	46.51	35.91	41.62	43.42	41.42	35.60	30.02	44.84	52.14	36.33	48.36	[1]39.08	33.66	39.07
1884	[1]48.28	31.01	[1]42.24	[1]44.00	[1]38.76	[1]45.02	49.19	40.51	30.57	34.61	36.76	34.95	35.40	42.50	40.85	40.40	43.15	46.62	44.07	39.99	36.28	[1]39.49	40.32	40.22
1885	[1]38.92	37.13	[1]29.82	37.00	[1]33.44	[1]33.80	40.58	31.80	32.58	44.37	39.50	35.78	41.23	38.84	38.40	33.00	31.42	35.81	38.04	40.51	35.93	[1]33.00	28.48	36.06
1886	[1]33.73	31.92	[1]30.98	25.71	[1]33.60	[1]35.76	28.78	34.05	31.46	26.77	32.46	31.24	30.94	42.77	36.00	34.70	32.36	35.31	35.03	32.21	27.95	[1]34.46	23.39	32.24
1887	[1]35.22	31.54	[1]24.25	30.45	32.56	[1]26.54	38.89	26.47	30.46	29.13	36.16	33.24	33.52	33.06	33.00	22.96	23.01	32.75	30.98	34.48	31.10	[1]29.12	15.08	30.17
1888	[1]27.52	31.99	[1]30.44	30.82	35.47	[1]29.04	23.06	28.20	23.49	30.86	34.10	26.41	31.00	37.82	36.17	31.22	25.89	25.96	30.40	28.03	26.56	[1]28.08	26.35	29.52
1889	[1]26.11	27.97	[1]28.45	28.10	32.56	[1]29.69	20.17	28.52	31.70	34.95	32.30	24.52	35.00	35.91	28.78	28.56	26.77	24.02	27.63	28.50	23.78	[1]26.37	34.27	28.90
1890	37.57	33.88	[1]32.14	33.41	38.34	[1]33.74	36.98	32.86	30.09	32.69	32.61	36.44	37.85	31.43	37.23	29.88	30.02	32.26	26.60	35.96	31.91	[1]28.19	37.67	33.47
1891	25.68	30.70	[1]29.08	21.40	26.03	23.95	24.24	24.67	29.76	26.54	31.09	31.29	32.70	35.14	32.25	30.69	24.83	26.26	28.89	34.41	24.78	[1]27.06	32.40	28.43
1892	32.29	46.32	32.22	34.34	33.02	35.20	37.10	32.76	35.03	36.56	44.45	43.21	40.35	36.29	38.55	29.35	32.76	31.77	40.83	33.33	29.92	[1]30.06	29.63	35.45
1893	32.40	32.53	32.00	29.73	32.99	29.75	31.46	30.95	32.87	27.47	29.10	29.95	35.40	30.80	33.35	27.75	26.26	34.97	42.57	34.80	31.29	[1]29.16	25.07	31.42
1894	26.45	31.53	27.56	25.16	35.89	23.80	24.59	25.48	27.79	27.46	25.26	35.49	30.63	29.36	31.95	27.81	27.03	32.61	26.18	26.07	19.30	[1]27.46	32.43	28.14
1895	18.14	20.42	27.29	15.59	21.04	24.64	13.49	20.16	24.88	32.38	27.02	25.90	27.92	26.37	26.70	26.96	34.30	25.62	31.11	31.57	22.80	[1]23.00	27.66	25.00
1896	35.09	31.86	29.47	31.91	33.09	32.20	31.35	31.23	28.98	33.14	34.94	32.52	35.46	30.49	29.26	30.15	33.65	30.18	29.50	43.40	33.22	[1]26.84	31.77	32.16
1897	30.15	24.66	27.28	27.01	34.13	25.50	22.58	26.58	31.05	25.85	30.93	25.17	32.39	34.66	31.53	30.93	28.55	32.32	30.69	36.49	33.61	23.42	27.49	29.26
1898	28.72	40.60	27.49	25.16	29.08	30.40	31.91	25.70	32.43	33.77	44.35	38.65	38.32	38.49	36.17	37.66	30.11	36.02	34.61	28.93	32.42	24.66	32.86	32.98
1899	30.17	28.03	32.63	23.90	25.76	31.30	26.81	21.30	22.82	26.49	26.62	23.94	31.77	26.72	34.53	31.38	25.26	27.98	29.55	36.48	23.67	23.36	33.41	27.99
1900	37.63	33.97	37.83	27.45	32.76	46.55	28.78	29.34	30.10	28.65	33.08	33.68	34.55	33.96	33.44	38.57	26.86	32.33	35.30	35.29	31.62	27.30	46.46	33.72
1901	27.68	18.86	32.71	24.63	26.46	33.00	20.24	25.91	18.69	24.52	27.28	19.70	30.93	32.65	27.90	36.49	29.97	26.45	36.07	21.79	32.49	29.75	35.91	27.83
1902	32.14	39.87	27.26	29.86	27.61	27.70	31.25	32.90	28.63	37.57	56.11	39.06	41.53	33.62	34.90	24.09	22.21	34.81	39.86	38.17	38.50	27.59	31.43	33.77
1903	33.68	32.96	43.27	29.49	28.89	42.86	34.40	32.16	33.41	28.09	32.63	35.91	42.32	33.43	33.89	19.42	32.58	33.19	35.60	35.55	35.93	21.07	40.96	33.55
1904	30.22	28.66	29.43	28.51	30.63	43.00	31.25	30.29	29.86	26.14	31.36	28.04	31.47	29.69	33.13	23.98	31.70	23.97	27.93	29.44	25.90	21.45	27.43	29.28
1905	42.00	30.82	32.51	32.86	31.91	39.15	25.49	31.75	32.19	35.36	39.34	40.72	39.27	33.85	40.23	23.72	31.42	37.85	44.36	34.02	39.02	29.26	19.34	34.19
1906	39.21	29.26	40.23	33.44	37.90	39.30	32.38	30.46	30.18	30.87	32.37	28.59	35.53	26.12	39.37	17.99	31.70	29.82	28.89	31.65	29.27	33.64	19.63	31.64
1907	30.02	35.84	23.02	32.35	27.32	26.30	30.29	29.74	34.90	35.10	38.08	34.18	43.58	25.35	32.96	19.81	24.30	36.04	33.39	36.72	34.55	32.42	30.29	31.59
1908	28.73	33.08	24.21	26.70	21.91	35.34	25.67	28.52	28.32	34.83	33.13	31.77	33.06	30.81	34.31	25.73	23.93	33.35	31.17	30.26	26.63	28.98	24.13	29.33
1909	27.50	41.01	35.84	28.12	26.78	29.99	30.83	30.89	31.51	43.22	37.38	38.80	43.76	35.05	38.05	27.25	31.65	38.01	39.71	42.68	29.72	34.55	20.04	34.01
1910	22.18	23.00	22.00	20.75	29.14	24.50	24.37	25.92	21.10	26.86	24.29	22.48	33.11	29.95	24.84	22.67	27.43	25.73	23.53	30.44	25.08	26.56	24.31	25.23
1911	42.65	37.30	36.78	28.72	30.69	44.45	32.73	37.01	26.25	33.83	45.57	34.90	36.85	33.57	38.04	27.21	36.33	40.58	45.11	32.75	31.12	28.08	29.28	34.77
1912	35.12	36.01	28.25	37.53	33.32	40.99	32.32	34.38	34.59	29.67	24.10	35.29	38.23	36.02	44.03	25.58	27.32	32.43	35.20	39.45	33.50	45.67	19.31	33.40
1913	37.18	31.59	31.16	37.07	30.83	34.12	36.04	32.66	30.38	27.11	28.67	33.74	34.48	37.01	28.68	22.15	26.60	24.34	23.68	25.04	31.05	29.42	25.30	30.36
1914	32.25	32.28	30.66	32.30	38.03	26.50	28.17	30.30	32.48	28.61	26.38	31.58	31.80	41.42	27.32	25.09	28.85	35.80	29.83	30.97	30.37	34.27	24.26	30.85
1915	32.75	35.30	35.05	32.66	27.74	33.72	38.23	30.97	29.76	33.34	29.46	30.49	33.61	33.95	28.40	25.86	27.89	35.73	28.93	30.07	32.41	31.10	22.62	31.31
1916	40.27	39.19	32.12	35.07	34.19	31.43	35.33	37.38	38.05	34.05	33.38	38.73	33.86	44.20	28.08	33.59	32.31	37.75	38.58	38.02	29.48	34.98	28.60	35.16
1917	29.09	25.20	19.08	27.64	22.27	22.97	29.40	27.92	33.39	24.66	25.11	25.37	22.17	32.24	24.75	24.10	24.77	29.62	33.45	32.36	32.68	24.30	23.91	26.80
1918	37.13	30.15	26.07	28.34	31.57	28.99	27.27	36.19	28.00	33.25	31.15	28.96	34.07	36.32	29.16	29.74	27.50	30.78	31.10	37.79	31.95	28.94	26.08	30.89
1919	39.19	34.12	25.15	33.11	26.95	36.25	35.16	33.51	30.46	33.49	29.98	37.08	30.51	33.66	30.88	30.67	29.63	34.07	30.20	30.41	31.47	28.69	27.36	31.82
1920	33.69	25.61	28.34	34.68	28.76	25.83	27.16	36.36	27.86	30.21	28.50	27.36	28.83	34.96	31.64	33.05	24.72	25.13	30.01	35.14	28.44	30.73	23.68	30.03
1921	25.35	36.76	32.62	32.88	26.09	27.99	38.56	29.17	35.02	36.10	36.47	42.36	36.76	33.48	30.14	32.98	29.42	36.45	39.98	38.81	34.25	31.33	30.16	33.61
1922	36.93	30.25	35.52	30.59	34.48	28.90	32.04	34.36	25.64	31.57	28.84	25.54	28.30	40.01	34.39	32.25	33.92	32.77	35.15	29.34	28.08	34.21	32.02	31.96
1923	29.86	31.36	30.25	28.71	24.14	26.12	31.01	32.95	30.86	32.48	31.89	30.99	35.40	34.59	28.13	25.33	27.98	29.14	27.52	34.72	31.08	27.90	24.10	29.85
1924	39.07	32.56	28.70	38.68	30.63	31.41	32.38	43.04	32.30	34.96	31.62	28.92	33.45	39.38	25.16	33.34	24.59	29.45	28.53	40.32	27.77	28.84	24.90	32.18
Means	33.87	33.40	31.37	31.02	31.98	33.16	31.94	31.28	31.04	33.09	34.19	32.77	35.73	35.59	33.88	30.72	30.48	33.63	34.18	34.79	31.26	30.63	29.29	32.57

[1] Interpolated.

TABLE 4.—*Annual precipitation in the drainage area of Lake Huron, 1875–1924 (inches)*

	Alma (near), Mich.	Alpena, Mich.	Cheboygan (near), Mich.	Flint (near), Mich.	Harbor Beach (near), Mich.	Harrisville (near), Mich.	Lansing, Mich.	Mio (near), Mich.	Port Huron, Mich.	Beatrice (near), Ont.	Lucknow (near), Ont.	Orillia (near), Ont.	Parry Sound, Ont.	Providence Bay (near), Ont.	Rutherglen (near), Ont.	Saugeen, Ont.	Means
1875	[1]34.34	37.27	[1]33.58	[1]28.80	[1]30.65	[1]37.46	28.44	[1]40.26	29.14	39.54	30.86	33.11	39.15	41.12	[1]27.40	33.33	34.03
1876	[1]39.90	37.62	[1]35.10	[1]33.99	[1]35.95	[1]40.71	30.55	[1]46.09	37.16	41.72	30.24	28.95	40.57	34.26	[1]28.40	36.12	36.08
1877	[1]34.88	41.00	[1]34.26	[1]34.40	[1]33.42	[1]41.05	37.42	[1]40.27	31.61	35.26	28.64	30.86	31.59	23.56	[1]24.32	29.71	33.27
1878	[1]42.26	38.48	[1]32.03	[1]36.10	[1]37.99	[1]42.35	31.97	[1]38.24	39.91	46.66	39.39	41.78	37.59	33.15	[1]30.51	41.47	38.12
1879	[1]31.49	39.97	[1]31.78	[1]27.14	[1]30.46	[1]38.77	26.72	[1]42.75	27.54	43.12	35.97	34.97	35.56	30.76	[1]27.07	35.94	33.75
1880	[1]45.93	43.63	[1]37.32	[1]41.76	[1]38.83	33.86	45.08	[1]49.10	38.68	59.51	33.31	38.98	42.85	20.88	[1]31.77	37.87	39.96
1881	[1]42.79	45.61	[1]35.58	[1]34.98	[1]37.25	37.42	34.66	[1]48.31	35.27	38.08	28.06	25.27	33.26	[1]34.60	[1]25.77	32.97	35.62
1882	[1]45.50	45.10	[1]38.28	[1]36.92	[1]40.82	39.29	32.88	[1]47.14	41.04	43.87	29.97	26.03	34.84	[1]36.99	[1]34.33	28.16	37.57
1883	[1]48.34	35.32	[1]33.66	[1]42.44	[1]35.10	36.74	48.36	[1]38.12	36.98	54.41	36.65	39.10	43.01	[1]36.51	[1]33.57	37.97	39.77
1884	[1]39.62	35.53	[1]40.32	[1]32.60	[1]30.12	34.47	36.28	[1]40.82	29.19	47.82	28.75	32.97	34.44	[1]33.80	[1]31.11	34.13	35.12
1885	[1]39.32	34.71	[1]28.48	[1]34.82	[1]32.86	33.58	35.93	[1]36.39	33.81	41.96	42.16	32.15	40.40	[1]34.21	[1]29.48	37.50	35.48
1886	[1]35.36	40.12	[1]23.39	[1]28.93	[1]32.00	37.22	27.95	[1]39.70	29.84	43.01	39.92	37.36	39.14	[1]36.85	[1]32.51	36.47	34.90
1887	33.89	37.88	[1]15.08	[1]27.84	30.07	35.98	31.10	32.66	24.82	36.39	41.52	28.03	34.05	[1]31.70	[1]23.65	33.78	31.15
1888	27.06	29.36	[1]26.35	[1]25.40	23.12	29.67	26.56	26.07	24.33	33.52	37.66	22.23	32.62	[1]33.46	[1]24.70	31.54	28.35
1889	26.50	31.32	[1]34.27	21.84	24.64	32.69	23.78	23.42	22.22	35.77	42.66	33.88	31.20	[1]32.64	[1]27.76	35.11	29.98
1890	34.32	31.35	32.98	29.19	34.93	30.87	31.91	32.51	32.95	37.50	35.14	32.98	39.44	[1]36.95	[1]27.05	35.66	33.48
1891	34.75	31.61	32.40	25.03	28.70	40.31	24.78	28.74	33.81	40.65	39.13	33.01	38.06	[1]33.08	[1]31.49	37.90	33.34
1892	36.21	32.15	29.63	25.67	34.34	39.13	29.92	28.04	33.95	40.54	36.97	33.25	43.89	[1]35.38	[1]30.86	41.51	34.46
1893	37.00	33.35	25.07	33.44	33.78	38.54	31.29	26.52	34.80	45.58	47.73	40.14	48.03	[1]40.34	[1]35.23	34.73	36.60
1894	28.81	30.88	32.43	21.64	25.30	33.97	19.30	20.28	26.92	35.43	35.53	34.71	39.39	[1]36.43	[1]30.44	28.16	29.98
1895	24.41	21.59	27.66	21.34	24.83	28.72	22.80	23.61	26.11	35.03	33.92	29.37	38.14	[1]29.93	[1]28.19	32.95	28.04
1896	31.46	30.14	31.77	25.19	24.09	32.64	33.22	24.45	28.43	44.09	32.36	34.30	33.10	[1]32.62	[1]29.47	28.88	31.01
1897	35.42	32.59	28.84	26.09	28.62	37.95	33.61	36.70	32.10	47.74	40.90	43.66	46.28	[1]38.34	[1]34.64	40.41	36.49
1898	36.24	34.07	32.56	27.48	25.70	35.84	32.42	36.39	33.14	42.93	38.06	29.01	39.99	38.00	[1]31.70	30.90	34.03
1899	26.84	29.93	29.77	29.32	24.03	32.26	23.67	30.48	25.85	41.82	39.10	38.16	43.99	41.03	[1]31.73	32.05	32.50
1900	31.18	23.03	42.95	34.86	25.34	31.11	31.62	35.89	28.73	39.40	35.34	29.81	42.28	36.08	[1]30.19	31.49	33.08
1901	27.57	25.23	30.34	28.28	17.46	31.71	32.49	28.40	20.36	41.92	36.40	34.81	50.30	37.41	[1]30.94	35.96	31.85
1902	37.57	29.02	24.03	38.90	34.69	34.59	38.50	32.17	35.77	43.36	36.54	38.11	45.23	32.92	[1]33.40	34.72	35.60
1903	38.30	31.54	22.74	36.83	28.88	36.05	35.93	34.27	32.91	40.00	37.71	34.93	38.22	39.01	[1]28.90	35.92	34.51
1904	28.93	24.68	27.43	25.31	18.65	31.71	25.90	32.01	25.97	36.73	42.01	28.59	39.27	32.12	[1]34.05	29.02	30.15
1905	40.20	28.14	19.34	34.96	24.70	32.73	39.02	30.46	28.97	41.95	41.87	32.41	42.99	29.82	[1]31.45	38.39	33.59
1906	36.02	35.22	19.63	27.48	23.42	38.50	29.27	32.00	27.33	41.03	38.16	29.03	44.58	27.51	[1]24.08	34.00	31.70
1907	33.88	22.68	30.29	29.45	18.84	31.81	34.55	32.10	27.42	39.03	34.76	23.55	37.42	26.83	23.70	26.26	29.54
1908	33.82	25.61	24.13	27.98	26.15	31.33	26.63	35.92	24.20	37.86	36.57	24.85	35.10	30.49	20.67	27.78	29.32
1909	39.32	23.75	29.81	28.59	29.54	29.79	29.72	33.82	27.82	40.63	45.14	29.31	41.58	28.89	25.42	41.78	32.81
1910	26.55	24.50	28.59	26.78	24.56	28.08	25.08	35.68	25.52	35.89	40.91	27.99	38.09	30.32	25.03	36.33	30.00
1911	35.31	27.23	34.82	27.59	30.65	32.17	31.12	43.32	26.50	34.78	36.54	20.96	31.92	26.72	23.59	31.77	30.94
1912	39.69	27.03	31.50	33.63	35.67	43.62	33.50	37.99	31.06	45.76	49.60	37.43	44.69	21.00	32.26	39.65	36.50
1913	32.17	26.50	25.07	32.38	25.72	25.31	31.05	21.14	32.61	36.31	35.22	25.78	38.69	31.45	26.22	31.98	29.85
1914	37.63	22.79	23.55	24.51	23.46	21.54	30.37	24.04	22.97	36.93	31.39	32.15	35.20	24.95	22.36	28.04	27.62
1915	30.26	27.22	26.68	28.98	28.49	26.42	32.41	28.27	25.78	34.98	36.25	24.65	30.42	19.31	27.45	33.29	28.80
1916	33.25	27.63	31.05	32.82	29.84	27.30	29.48	35.85	25.58	45.63	40.33	34.21	48.15	25.65	35.81	43.37	34.12
1917	28.13	23.79	22.14	28.60	27.65	25.84	32.68	24.55	25.32	34.62	43.05	36.15	45.91	28.64	35.29	37.90	31.27
1918	32.34	28.90	29.86	26.60	28.31	25.39	31.95	25.15	24.91	35.96	37.13	36.87	36.57	37.83	31.95	35.27	31.56
1919	34.15	26.72	33.90	27.57	23.47	22.25	31.47	28.72	24.82	46.07	42.08	33.63	40.83	35.21	30.19	29.43	31.91
1920	30.29	26.91	28.41	28.57	25.67	24.72	28.44	27.27	26.34	36.52	37.14	33.21	31.05	35.07	25.67	33.53	29.93
1921	37.92	32.94	29.51	37.59	24.66	32.39	34.25	34.11	27.65	37.43	40.51	25.47	39.48	36.22	31.50	35.83	33.59
1922	33.70	28.53	32.54	28.55	30.57	30.98	28.08	32.45	25.61	30.14	30.19	28.33	37.59	32.04	27.47	36.53	30.83
1923	32.87	26.04	23.42	29.05	25.31	25.97	31.08	28.82	25.78	31.09	32.53	30.69	33.05	23.93	30.51	29.90	28.75
1924	27.00	25.00	29.79	31.57	24.95	26.26	27.77	27.45	22.75	38.23	33.34	33.98	38.75	40.43	31.02	37.98	31.02
Means	34.61	31.03	29.68	30.20	28.68	32.98	31.26	33.18	29.25	40.28	37.11	32.02	38.96	32.53	29.24	34.43	32.84

[1] Interpolated.

TABLE 5.—*Annual precipitation in the drainage area of Lake Erie, 1875–1924 (inches)*

	Ann Arbor (near), Mich.	Detroit, Mich.	Benton Ridge (near), Ohio	Cleveland, Ohio	Ruggles (near), Ohio	Sandusky, Ohio	Toledo, Ohio	Warren (near), Ohio	Wauseon, Ohio	Erie, Pa.	Buffalo, N. Y.	Jamestown (near), N. Y.	Chatham (near), Ont.	Cottam (near), Ont.	Dutton (near), Ont.	Georgetown (near), Ont.	London (near), Ont.	Paris (near), Ont.	Port Dover, Ont.	Port Stanley (near), Ont.	Woodstock, Ont.	Means
1875	30.08	35.71	39.65	36.91	33.95	[1]35.68	28.03	30.15	38.28	41.20	31.44	41.57	[1]29.20	[1]38.57	[1]27.10	34.87	32.53	34.00	30.08	29.36	34.11	33.93
1876	42.15	40.40	47.53	41.19	38.73	[1]42.77	34.55	36.45	49.58	44.65	39.26	40.40	[1]35.21	[1]43.63	[1]32.80	29.45	42.54	31.60	37.95	38.09	39.08	39.43
1877	32.61	35.23	35.80	33.13	29.95	35.52	35.17	32.88	38.56	38.96	34.48	32.40	[1]31.15	[1]38.05	[1]25.85	28.25	32.62	26.40	29.56	34.60	26.69	32.76
1878	39.89	43.39	41.20	53.51	37.00	42.91	32.67	45.09	37.24	55.23	60.24	47.15	[1]38.18	[1]46.86	[1]37.97	43.70	44.23	41.81	41.58	42.16	46.90	43.76
1879	37.22	37.17	37.75	41.52	31.35	37.71	30.27	32.52	36.69	36.25	30.47	34.88	[1]31.60	[1]40.14	[1]29.80	26.00	34.53	29.87	28.56	33.46	36.48	34.01
1880	44.25	47.68	40.80	37.38	33.30	39.44	35.72	31.19	41.00	40.94	39.26	36.40	[1]38.74	[1]51.49	[1]31.29	24.60	39.23	33.34	33.44	38.60	35.22	37.78
1881	39.93	45.44	42.25	34.96	32.70	46.31	45.91	39.65	48.06	37.62	35.95	37.40	[1]35.14	[1]49.18	[1]29.54	23.60	35.75	33.34	31.15	32.52	36.72	37.77
1882	36.21	30.32	35.65	39.98	30.85	42.53	33.03	34.41	33.56	46.37	33.82	41.25	[1]28.00	29.21	[1]28.26	27.38	35.27	29.67	31.07	32.64	33.80	33.97
1883	33.27	32.57	43.80	41.13	36.85	41.89	34.24	38.49	41.59	44.81	38.07	43.71	32.46	32.41	35.79	33.06	45.94	24.29	38.89	36.27	40.72	38.11
1884	29.18	28.17	36.80	33.26	24.35	33.64	28.43	33.73	32.91	45.47	37.07	48.97	28.42	31.24	32.56	32.60	39.85	29.09	21.48	27.02	38.51	32.99
1885	35.14	28.24	39.89	39.93	35.65	34.23	33.19	33.21	36.00	52.13	52.36	46.32	33.88	37.93	32.05	36.86	40.62	36.21	30.19	35.43	38.07	37.50
1886	28.39	26.71	30.35	27.34	32.20	31.00	32.70	30.63	30.38	37.49	44.85	36.90	29.89	34.22	33.74	35.01	39.89	34.11	38.91	37.91	30.62	33.49
1887	28.63	28.97	32.85	35.36	31.45	29.85	32.01	38.71	34.14	45.14	31.55	38.23	32.64	37.41	30.48	29.07	30.32	28.43	25.66	29.63	30.19	32.42
1888	27.23	29.02	36.95	32.57	34.61	26.45	25.86	36.57	28.49	31.94	33.87	39.13	29.17	32.79	25.67	24.25	31.07	27.41	32.63	30.80	26.47	40.62
1889	24.80	21.06	34.39	32.57	35.03	24.89	21.84	26.72	35.33	37.66	40.07	45.71	28.81	34.10	28.19	32.77	36.73	32.59	26.63	35.85	32.16	31.80
1890	35.35	34.99	42.75	47.82	47.09	38.60	33.64	48.59	39.29	47.05	46.55	59.49	41.04	38.97	33.60	34.30	41.04	34.01	37.78	40.15	40.81	41.09
1891	31.24	28.83	37.92	34.18	36.28	30.69	27.12	37.94	37.11	30.24	30.74	45.08	29.56	29.23	33.02	33.00	42.22	35.63	28.38	35.27	38.34	33.91
1892	29.93	37.11	42.74	36.51	39.49	43.28	36.70	40.56	52.55	41.67	45.87	47.07	38.36	37.54	30.07	30.20	45.88	38.57	32.70	38.31	37.83	39.19
1893	38.98	34.18	33.91	33.88	41.95	29.00	23.81	42.66	42.74	39.99	38.64	52.42	31.10	35.34	36.14	43.39	38.79	37.05	34.06	40.94	27.11	36.96
1894	25.64	25.74	30.70	27.73	26.97	28.09	21.34	35.74	32.04	35.16	38.92	47.66	25.92	26.67	28.38	27.61	34.45	31.10	32.58	30.54	28.05	30.53
1895	22.75	25.04	24.68	26.84	32.64	26.82	25.31	32.66	29.06	35.55	32.02	30.70	24.74	26.57	29.42	30.05	34.80	27.97	31.03	30.94	29.71	29.01
1896	30.05	36.20	37.30	36.68	42.25	31.76	33.10	42.31	46.57	37.02	37.29	48.90	37.77	37.31	31.80	30.46	34.36	32.91	33.90	36.68	25.82	36.21
1897	32.51	30.34	36.40	24.54	34.96	28.45	30.35	41.71	38.85	34.34	37.72	42.48	33.58	35.72	32.64	35.74	35.37	33.83	41.18	34.47	30.33	34.55
1898	33.00	34.34	39.76	32.54	43.03	43.17	28.10	43.63	44.93	34.07	33.50	52.72	36.67	36.98	33.86	34.41	44.45	34.94	32.05	39.50	31.35	37.48
1899	25.86	26.41	28.95	24.53	30.59	30.78	27.06	32.64	36.81	28.36	29.39	44.67	26.04	31.34	25.09	31.83	34.03	26.73	27.51	30.61	26.54	29.80
1900	28.58	31.45	36.35	25.83	37.76	31.80	29.58	33.87	39.38	32.62	35.93	45.06	33.75	33.70	32.36	30.98	33.78	33.48	37.19	36.09	26.25	33.61
1901	26.09	28.78	27.55	38.71	36.94	25.50	26.29	44.20	35.32	31.67	35.49	45.70	25.43	25.95	21.27	35.77	24.64	26.76	28.46	32.50	32.85	31.23
1902	41.55	35.53	36.47	39.89	35.37	36.83	33.31	38.79	44.85	29.79	32.91	41.97	30.57	34.85	23.54	33.26	30.93	30.54	32.79	42.59	34.27	35.27
1903	35.95	35.88	38.20	35.41	34.37	33.57	35.08	35.98	38.93	35.58	37.95	41.93	30.71	37.03	27.70	36.82	34.51	30.13	38.81	41.15	30.01	35.51
1904	28.19	28.32	36.82	34.56	41.19	31.87	27.94	40.87	36.36	34.96	35.83	49.56	25.86	31.07	23.82	36.32	40.92	37.46	36.04	35.13	32.49	34.55
1905	36.54	32.00	42.04	31.90	39.95	28.90	28.59	38.65	34.27	33.63	35.85	43.24	25.65	28.72	19.68	33.06	34.77	29.18	31.13	28.56	28.24	32.60
1906	30.92	33.67	32.64	31.62	40.28	34.83	30.27	38.40	33.29	38.42	33.63	34.43	26.72	32.16	32.69	36.61	42.16	33.21	29.32	35.58	37.31	34.03
1907	31.32	30.62	39.24	34.76	40.39	38.44	35.03	37.16	34.81	37.95	34.97	43.84	20.52	39.30	33.97	29.88	38.98	34.48	35.88	32.79	32.80	35.10
1908	31.04	28.59	32.93	27.60	34.30	26.48	35.88	41.27	32.79	26.72	34.24	34.61	20.89	32.86	24.19	33.04	35.95	31.55	29.58	28.89	31.21	31.17
1909	29.98	40.65	49.41	34.29	39.74	38.31	40.42	36.12	44.21	33.88	36.97	42.89	30.44	42.30	29.99	28.27	41.90	36.04	41.76	38.37	27.82	37.32
1910	27.08	24.98	37.88	33.65	37.40	32.48	29.13	37.05	32.46	35.76	42.43	40.38	29.30	32.72	22.11	33.11	37.32	34.54	36.33	38.42	28.68	33.49
1911	29.24	28.63	34.80	37.37	43.76	35.82	39.11	47.07	40.74	37.24	37.03	50.13	30.58	37.80	21.63	28.06	43.85	31.22	37.59	38.28	32.11	36.29
1912	29.06	29.66	35.36	35.94	36.51	31.76	31.95	45.58	30.43	42.09	33.22	44.36	31.64	35.44	26.25	32.07	48.32	38.85	40.40	37.19	32.28	35.64
1913	26.83	34.16	46.32	40.80	49.81	40.43	42.14	46.11	40.90	38.27	33.14	46.97	30.46	35.34	19.20	31.17	43.59	36.97	41.89	41.85	26.08	37.73
1914	32.28	30.56	33.62	28.11	39.54	31.41	35.10	38.76	32.60	36.28	34.38	40.48	29.72	31.04	23.57	25.71	35.46	31.53	34.98	37.19	32.39	33.08
1915	28.16	34.92	38.64	27.06	33.26	33.09	33.65	36.70	34.41	37.82	31.84	42.01	33.30	38.17	37.77	37.70	42.33	33.55	43.81	39.39	37.82	35.97
1916	35.57	32.21	34.77	25.94	32.58	27.20	30.54	36.23	32.54	35.44	33.38	43.23	31.44	30.28	34.20	32.19	35.49	35.42	40.68	43.46	33.79	34.12
1917	41.44	30.05	36.75	34.49	31.62	32.03	32.19	36.94	36.75	42.25	38.67	47.42	28.69	36.10	35.19	27.27	43.20	40.00	50.60	37.16	35.75	36.88
1918	33.23	31.19	30.62	27.65	32.30	25.12	31.78	32.73	29.80	38.11	32.21	41.29	18.59	23.98	23.15	31.78	36.24	34.10	38.21	30.87	34.16	31.29
1919	35.37	34.86	39.84	30.00	41.94	28.78	31.43	32.94	32.45	31.55	28.12	43.03	20.34	24.76	25.28	26.49	42.99	34.99	35.68	35.09	30.40	32.68
1920	34.87	30.70	37.03	29.94	35.21	28.07	35.78	31.76	36.05	30.71	30.77	31.90	24.45	26.12	25.22	27.85	36.77	35.71	[1]32.66	41.56	28.50	31.98
1921	33.04	31.46	36.88	32.78	36.20	32.29	34.03	38.30	33.54	35.92	26.71	43.33	30.66	31.37	23.50	28.51	40.85	42.55	[1]39.68	31.79	34.42	34.18
1922	26.14	28.83	38.43	26.21	31.87	26.81	34.04	33.15	31.89	29.73	29.41	36.17	23.98	24.73	29.53	25.07	37.79	38.20	33.33	29.55	33.53	30.88
1923	31.75	30.59	37.08	30.75	34.26	30.00	33.71	35.79	34.93	26.43	25.31	32.49	27.15	28.37	29.33	27.80	33.75	38.60	40.88	27.08	32.71	31.85
1924	25.23	24.39	36.82	32.98	33.78	36.24	31.46	39.01	30.50	34.20	33.37	44.60	29.59	23.95	30.97	27.78	31.27	37.98	39.90	32.06	31.51	32.74
Means	32.07	32.12	37.15	33.88	36.07	33.47	31.97	37.45	36.92	37.25	35.94	42.65	29.95	34.22	29.02	31.38	37.89	33.64	34.75	35.29	32.78	34.57

[1] Interpolated.

TABLE 6.—*Annual precipitation in the drainage area of Lake Ontario, 1875–1924 (inches)*

	Appleton (near), N. Y.	Auburn (near), N. Y.	Buffalo, N. Y.	Friendship (near), N. Y.	Oswego, N. Y.	Penn Yan (near), N. Y.	Perry City (near), N. Y.	Rochester, N. Y.	Sacketts Harbor (near), N. Y.	Aurora (near), Ont.	Kingston, Ont.	Lakefield (near), Ont.	Lindsay, Ont.	Peterboro (near), Ont.	Stoney Creek (near), Ont.	Toronto, Ont.	Means
1875	23.82	29.75	31.44	31.34	31.41	26.90	30.93	29.93	23.16	*28.10	28.48	24.37	*29.52	27.59	33.64	29.73	28.76
1876	22.59	35.79	39.26	36.14	34.20	33.81	39.32	35.82	25.72	*25.47	30.40	27.55	*31.20	27.16	36.73	32.40	32.10
1877	21.27	32.35	34.48	25.36	32.20	31.07	32.01	34.12	32.29	*22.63	30.38	25.30	*27.08	22.03	21.38	25.61	28.10
1878	40.82	48.85	60.24	39.26	55.83	41.43	49.39	48.81	38.85	*36.60	47.34	40.31	*44.51	37.64	46.16	48.49	45.28
1879	26.20	31.50	30.47	33.42	36.60	23.93	30.29	35.22	22.26	*21.34	32.95	23.21	*25.48	21.41	29.66	29.37	28.33
1880	25.38	35.41	39.26	31.94	43.19	23.87	32.79	41.80	23.95	*25.06	31.22	28.97	34.06	31.09	29.31	35.32	32.04
1881	24.26	36.45	35.95	37.20	39.25	30.44	37.88	38.24	22.78	*22.50	25.15	23.10	28.77	27.52	28.04	26.90	30.28
1882	24.17	28.50	33.82	36.17	36.13	23.46	29.62	24.73	25.37	*24.38	34.61	28.84	30.97	23.77	32.23	24.84	28.85
1883	29.19	33.55	38.07	41.21	34.49	33.77	35.44	30.50	28.33	*23.24	38.39	34.49	40.83	18.59	27.77	34.13	32.62
1884	16.71	27.52	37.07	48.97	31.47	26.73	34.17	31.17	29.12	30.54	36.82	28.70	34.92	33.84	27.68	28.55	31.50
1885	25.87	39.20	52.36	46.40	33.14	30.20	35.10	28.31	28.11	27.24	42.04	27.94	29.86	31.51	36.87	32.91	34.19
1886	20.02	48.07	44.85	36.90	35.46	31.73	32.92	36.84	29.54	28.57	41.73	27.86	33.64	32.48	38.67	35.08	34.65
1887	15.63	36.36	31.55	38.23	23.41	26.36	30.59	20.30	22.90	22.37	32.66	22.30	32.77	22.67	33.46	25.76	27.33
1888	23.40	44.39	33.87	34.04	32.79	31.09	30.97	27.76	30.81	22.76	32.71	22.38	27.10	27.10	30.18	26.28	29.85
1889	28.82	48.54	40.07	43.22	40.10	39.99	46.85	35.70	55.73	28.88	35.53	30.87	37.23	37.23	34.03	31.23	38.38
1890	34.62	47.42	46.55	52.07	40.86	44.27	53.07	43.09	32.14	31.32	34.20	27.68	32.56	32.56	40.36	37.37	39.38
1891	25.18	28.04	30.74	34.52	31.44	33.76	38.60	33.64	29.12	27.87	30.02	22.96	34.17	31.62	37.68	31.52	31.30
1892	24.07	30.30	45.87	40.04	34.81	34.09	43.30	35.02	40.71	30.13	35.00	28.75	32.60	33.00	34.49	29.50	34.48
1893	35.01	24.59	38.64	40.22	34.78	29.74	37.90	35.50	39.13	28.32	36.56	33.83	35.30	43.30	45.62	39.71	36.13
1894	30.79	39.08	38.92	48.39	36.44	36.92	42.55	35.11	33.21	33.90	29.53	23.44	31.71	32.48	32.74	29.56	34.67
1895	25.23	29.32	32.02	32.35	32.48	28.14	31.22	30.42	30.08	25.48	26.03	31.52	26.84	27.30	35.37	28.01	29.49
1896	28.41	34.59	37.29	36.34	38.32	41.79	36.62	36.84	33.01	24.92	25.78	29.55	32.74	31.50	33.54	29.10	33.15
1897	29.26	29.07	37.72	37.15	36.61	31.89	32.12	30.12	24.05	30.87	28.32	37.62	42.33	35.99	38.67	32.48	33.39
1898	29.06	44.71	33.50	42.40	40.44	31.75	37.60	37.50	25.29	32.98	31.50	36.37	37.16	33.46	34.20	30.95	34.93
1899	25.45	34.50	29.39	28.02	34.65	25.70	30.21	26.76	21.67	26.60	27.51	30.95	37.29	34.59	28.87	28.98	29.45
1900	29.09	38.15	35.93	35.49	37.17	30.48	35.77	38.12	34.40	28.00	30.84	30.33	35.98	35.71	37.74	29.59	33.92
1901	31.07	42.40	35.49	41.94	45.09	35.33	43.62	37.20	40.66	32.18	35.35	33.93	35.69	32.60	35.26	32.27	36.88
1902	32.74	39.04	32.91	45.72	37.87	29.18	40.85	29.73	34.53	26.96	30.44	34.71	43.01	37.79	32.57	31.02	34.94
1903	30.52	40.16	37.95	36.04	39.65	33.96	43.67	29.44	36.98	28.49	33.43	28.25	30.52	29.04	37.34	30.63	34.13
1904	26.77	41.59	35.83	35.74	39.51	34.37	36.68	34.56	37.51	31.97	34.61	26.89	38.13	34.30	41.19	35.69	35.33
1905	26.60	41.93	35.85	37.82	38.10	30.67	38.34	33.50	47.73	32.20	37.22	27.12	38.66	30.65	33.98	31.25	35.10
1906	27.83	42.90	33.63	40.35	36.23	30.69	39.29	29.74	34.31	35.83	32.26	30.20	40.23	38.13	35.05	30.98	34.85
1907	29.01	33.84	34.97	31.03	38.36	23.86	37.21	27.60	36.15	27.62	21.83	24.83	36.51	29.29	36.64	30.76	31.22
1908	23.27	30.05	34.24	33.58	33.93	23.11	33.37	27.49	31.11	28.58	33.37	27.04	37.32	27.44	23.24	29.50	29.79
1909	29.03	31.51	36.97	28.78	37.59	22.22	29.30	29.49	31.58	31.98	37.99	30.91	46.46	33.21	31.26	32.92	32.58
1910	31.78	40.48	42.43	33.68	36.99	30.12	35.56	35.52	29.35	29.18	33.36	34.50	56.08	31.12	30.92	33.63	35.29
1911	20.60	27.99	37.03	33.93	36.90	28.83	35.01	32.88	31.07	26.43	32.72	27.95	28.78	31.20	24.79	29.16	30.33
1912	28.12	45.19	33.22	32.94	40.60	26.85	31.41	29.45	39.45	35.69	36.83	35.61	45.38	40.06	31.23	32.53	35.28
1913	29.29	37.01	33.14	35.13	34.64	29.51	33.26	33.20	36.18	36.78	33.51	27.63	29.47	24.06	29.65	28.75	31.95
1914	24.06	38.58	34.38	34.91	29.80	30.47	39.61	29.83	25.77	27.00	25.16	24.35	23.37	24.20	24.91	27.17	28.97
1915	26.55	39.59	31.84	40.97	31.63	30.83	34.66	28.28	28.56	34.74	25.93	26.34	26.34	29.22	23.65	34.71	30.86
1916	29.39	34.21	33.38	37.36	28.33	39.39	29.27	36.14	37.68	31.77	37.42	30.47	30.48	31.95	25.76	31.99	32.81
1917	31.59	36.56	38.67	35.91	28.68	39.94	39.58	36.89	30.77	24.50	33.53	28.58	26.92	30.41	23.48	34.33	32.52
1918	27.02	32.52	32.21	36.49	31.25	27.06	35.88	29.35	30.98	24.42	33.05	36.94	31.67	36.88	22.90	34.41	31.44
1919	23.14	35.89	28.12	37.07	34.32	37.13	27.25	33.08	29.78	28.40	34.98	26.75	30.48	28.93	25.13	29.70	30.63
1920	20.55	36.21	30.77	30.03	32.31	27.35	33.83	27.69	31.36	28.50	27.49	22.45	27.76	30.77	23.56	29.92	28.78
1921	20.77	27.49	26.71	33.15	25.78	31.15	32.47	28.13	29.46	31.18	24.86	25.78	33.12	29.95	23.03	27.37	28.15
1922	25.60	38.27	29.41	31.33	33.10	36.61	37.18	33.02	33.08	26.23	27.35	19.23	23.68	26.95	26.39	29.14	29.79
1923	26.77	31.55	25.31	33.65	27.50	27.61	28.04	30.31	29.54	21.99	27.33	16.09	27.39	30.53	20.95	33.63	27.39
1924	32.90	32.53	33.37	37.03	31.33	30.04	31.47	31.59	32.58	30.88	32.81	29.17	28.75	31.48	22.01	33.89	31.3
Means	26.79	36.27	35.94	36.83	35.34	31.19	35.88	32.71	31.76	28.47	32.37	28.50	33.66	30.87	31.40	31.37	32.46

* Interpolated.

TABLE 7.—*Average annual precipitation (inches) in the drainage area of the Great Lakes, and average annual lake levels (feet above sea level), 1875–1924*

	Precipitation		Lake levels					Precipitation		Lake levels			
	Superior, Michigan, Huron, and Erie	All (5) lakes	Superior	Huron-Michigan	Erie	Ontario		Superior, Michigan, Huron, and Erie	All (5) lakes	Superior	Huron-Michigan	Erie	Ontario
1875	33.02	32.29	602.67	581.48	572.28	245.27	1901	29.79	31.00	602.75	580.53	571.39	245.06
1876	37.16	36.30	603.06	582.61	573.70	247.10	1902	32.99	33.32	602.53	580.21	571.84	245.27
1877	33.39	32.49	602.44	582.38	572.88	245.93	1903	34.13	34.13	602.73	580.36	572.39	245.87
1878	37.19	38.57	601.87	582.07	573.29	246.50	1904	30.46	31.29	602.71	580.86	572.54	246.64
1879	34.67	33.59	601.43	581.15	572.53	246.21	1905	33.28	33.59	602.74	580.98	572.17	246.21
1880	37.69	36.73	601.76	581.27	572.77	245.83	1906	31.71	32.25	602.63	581.05	572.26	246.05
1881	38.98	37.50	602.21	581.70	572.61	245.51	1907	30.75	30.83	602.51	581.06	572.73	246.66
1882	36.32	35.05	602.21	582.19	573.48	246.57	1908	29.58	29.62	602.27	580.99	572.69	247.29
1883	36.04	35.46	602.01	582.37	573.27	246.68	1909	33.55	33.39	601.93	580.50	572.15	246.12
1884	36.19	35.39	601.90	582.47	573.34	247.30	1910	27.73	29.01	601.78	580.15	571.87	245.67
1885	33.50	33.62	602.15	582.72	573.24	246.83	1911	33.58	33.02	601.44	579.60	571.47	245.05
1886	32.62	32.97	601.85	582.96	573.34	247.60	1912	32.84	33.26	602.09	580.07	572.02	246.14
1887	30.14	29.66	601.88	582.32	573.31	247.06	1913	32.14	32.11	602.32	580.68	572.95	247.00
1888	29.55	29.60	602.28	581.71	572.61	245.82	1914	29.85	29.70	602.38	580.24	572.17	246.05
1889	30.12	31.52	602.14	581.16	572.38	246.03	1915	31.45	31.35	602.09	579.73	571.68	245.10
1890	34.21	35.09	602.00	581.05	573.05	247.07	1916	33.98	33.78	603.10	580.35	572.29	246.36
1891	30.34	30.50	601.69	580.49	572.15	246.12	1917	29.50	30.01	602.48	581.16	572.73	246.40
1892	34.08	34.15	601.51	580.38	572.14	245.38	1918	30.03	30.27	602.07	581.40	572.25	246.44
1893	33.29	33.77	601.86	580.67	572.09	245.98	1919	31.13	31.05	602.31	580.91	572.77	246.65
1894	29.50	30.38	602.56	580.78	572.10	245.79	1920	29.74	29.58	602.38	580.56	571.91	245.40
1895	27.57	27.89	602.62	579.74	571.17	244.29	1921	32.32	31.61	602.13	580.10	572.30	245.75
1896	32.50	32.61	602.59	579.47	571.39	244.62	1922	30.58	30.44	602.01	579.98	572.00	245.73
1897	32.09	32.31	602.60	580.13	571.96	244.80	1923	29.11	28.82	601.75	579.38	571.41	245.02
1898	33.05	33.37	602.17	580.31	572.14	245.37	1924	30.58	30.71	601.42	579.06	571.68	245.43
1899	30.10	29.98	602.69	580.32	571.93	245.20	Means	32.34	32.36	602.20	580.88	572.40	246.00
1900	32.74	32.94	602.77	580.28	571.94	245.25							

Upper.—The third span of the Big Rock Bridge, about a mile below Franklin, Pa., floating down the Allegheny River on the ice gorge. This is perhaps the first time that a whole span of a steel bridge floated down a river on ice. The span traveled 1½ miles to a point near Venango. Two spans fell on the main-line tracks of the Pennsylvania Railroad five minutes after a street car laden with passengers had passed over the bridge. Photo March 28, 1926, by P. L. Mahaffey, Pennsylvania Railroad photographer

Lower.—The gorge near Venango, Pa., about 2½ miles below Franklin. The ice was moving toward the camera, and five minutes later had blocked the tracks. Here it was nearly 40 feet thick at times. Its movement was accompanied by terrifying sharp cracks and a grinding roar. Photo by P. L. Mahaffey, Pennsylvania Railroad photographer

Upper.—"Icebergs" at Franklin, Pa., heaved out upon the banks of the river when the gorge broke, some of them destroying buildings. Photo by P. L. Mahaffey, Pennsylvania Railroad photographer

Lower.—Ice stranded in back yards in Elk Street, Franklin, Pa., soon after the gorge had gone out. The water fell with such rapidity that floes were left stranded upon the upper crust of the gorge, which had formed in some places 200 yards from the normal bed of the river, as here. Photo by Pittsburgh Post staff photographer

THE ALLEGHENY RIVER ICE GORGE, WINTER OF 1926

By W. S. Brotzman

[U. S. Weather Bureau, Pittsburgh, Pa.]

The cold weather during the last week in December, 1925, made considerable ice over the Allegheny River, especially at the headwaters. Light rains and high temperature during the first week in January caused the ice to break up on the 6th and 7th, and during the night of the 7th ice was running from the headwaters to the mouth of the river at Pittsburgh.

On the 8th the ice became gorged on a small island about 15 miles below Franklin, Pa., and 1½ miles below Brandon, Pa., the river stage being 4 feet at Franklin. Ice from the upper river lodged against this gorge, and by the morning of the 10th the river channel between Brandon and Franklin was filled with ice from shore to shore to a depth of from 4 to 9 feet. The river continued rising at Franklin, due to backwater, a 9-foot stage being reached on the morning of the 10th, and 11.7 feet on the morning of the 12th.

Cold weather now set in, the temperature being below zero much of the time, and lasted until January 18. During this period the river discharge diminished until the backwater reading was only 7.6 feet on the morning of the 18th. The gorged ice in the channel was frozen into a solid mass resting on the river bed.

The river bed in this stretch of the Allegheny River averages about 800 feet in width, but at a point one-half mile below Indian Bend, near the lower end of the gorge, the river narrows rather abruptly to 350 feet. The bed is very stony; at low stages only about one-third of it is covered with water. These conditions made a favorable anchorage for the ice throughout the length of the gorge.

During the afternoon and night of the 18th, under the influence of higher temperatures, the new ice that had formed above Franklin during the cold spell began moving. The river rose rapidly at Franklin, reaching the flood stage, 15 feet, about noon of the 19th, and a crest stage of 20.3 feet by 5 a. m. of the 20th. At 6 a. m. of the 20th the gorged ice a short distance below Franklin began flowing over the original ice pack, piling the ice still higher near Brandon and for 6 miles above. The stage at Franklin soon dropped to 13.4 feet, with the river full of ice, but by 5 p. m. it had again risen to 16 feet, with ice still running. At Franklin this was lodging against the original gorge. On the morning of the 21st the stage at Franklin was 16.8 feet, and the gorge extended from Franklin to 1½ miles below Brandon. The river channel was filled with ice to a depth of 12 to 25 feet, anchored on the river bed.

Cold weather again set in on January 22, and continued with only a few brief interruptions and with temperatures frequently below zero until February 25. Much new ice formed above Franklin, and practically solidified the 15-mile gorge.

Rains and warm weather on February 25 and 26 started another ice movement in the main river, from Warren, Pa., to Franklin, and from the principal tributaries between Franklin and Warren. The small passages which had been worn through the large gorge were quickly jammed, and the water and floating ice began backing up in the vicinity of Franklin. By 9:20 p. m. of February 26 the low-lying sections of Franklin were inundated, and the top of the ice at the Franklin River gage registered 24 feet. At 8 a. m. of February 27 the top of the ice stood at 22.1 feet at Franklin, and the gorge extended from Brandon to Tionesta Creek, 41 miles.

The gorge readings at Franklin remained above the flood stage until March 5. At 8 a. m. of the 6th the water stage at Warren was 2 feet, and at Parkers Landing, below Franklin, 2.8 feet, while the ice-gorge stage at Franklin was 14.5 feet. Estimating from the stages above and below Franklin, it is believed that the actual depth of water at Franklin on the morning of March 6 was not more than 2.5 feet.

On March 20 rains and melting snow started another rise. During the night of March 20 the ice at Franklin was lifted to the flood stage, and during the next 12 hours moved downstream about 1½ miles, impinging on the ice below, leaving the river open at Franklin, but, on the following morning, at a stage of 20.6 feet on account of backwater from the gorge. This ice movement carried out three spans of the Citizens' Traction Co. bridge at Big Rock, about a mile below Franklin, the piers having become firmly embedded in the ice.

Meanwhile the ice above Franklin was lodged on a small island at the mouth of French Creek and on sand bars and shallow flat places between Franklin and Oil City, Pa., forming the "Oil City Gorge," which backed the water up to the highest level ever known in Oil City. The downtown streets were flooded and much damage resulted. This gorge menaced railroad and highway bridges near Oil City and caused much anxiety in Franklin lest it should break before the Franklin gorge.

Fortunately for Franklin, during the 22d and the 23d, the breaking up of the gorge below Franklin continued, large sections of the lower end at Brandon floating away, until at 4:00 p. m. on the 23d only 5 miles of the original 15-mile gorge remained, near Sandy Creek and Indian Bend. At 5:40 p. m. of the 23d the last section moved out, and the Allegheny Valley was free of a menace which had overhung it for 74 days. About one hour later the Oil City gorge followed.

The damage at Oil City was estimated to be about $500,000, and at Franklin about $100,000. Much of this loss was sustained by the Pennsylvania Railroad Co., whose tracks parallel the gorge throughout its length; by the local oil companies, through flooding of oil wells; and by other industries in the low-lying sections. Office buildings, stores, and residences were considerably damaged.

Efforts were made by the Pennsylvania Railroad Co. and the cities of Franklin and Oil City to remove the gorge or cut a channel through it sufficiently large to relieve the dangerous situation, by the use of explosives, especially of thermite.

Dr. H. T. Barnes, of McGill University, Montreal, Canada, the inventor of thermite, was engaged to conduct the work. He arrived at Oil City on March 3, and after a consultation with city and railroad officials proceeded to determine "key" locations where the thermite might be most effective. He then ordered a ton of it, which was shipped from Pittsburgh to Oil City that same night. In explaining the action of thermite, Doctor Barnes said: "It is nonexplosive and non-inflammable. After ignition in the container it generates heat at the rate of 5,000 ° F. in 10 seconds, and contact with the ice causes an upheaval which is followed by disintegration. The heat is forced into the ice so rapidly

that the ice has not time to melt, with the result that it explodes. It continues its disintegrating process for a period of 24 hours and weakens the gorge wherever placed."

Meanwhile, more than a hundred charges of dynamite were placed in the ice by the Pennsylvania Railroad Co., at Brandon, where the depth of ice was 12 feet. The first charge was set off at 11 a. m., March 4, and the dynamiting was continued until March 9, when a channel almost a mile long and 100 feet wide had been blown through the supposed neck of the gorge.

The first use of the thermite was at Venango Yards, some 6 miles above the dynamiting operations at Brandon on March 4. The 200-pound charge caused a heavy explosion, and a spectacular display of fire, smoke, and steam, but apparently little melting of the ice.

Thermite was used almost daily between Brandon and Venango until March 9, when, in the words of a Pennsylvania News staff reporter, "Movement of the gorge was abandoned in the hopelessness of the insurmountable task."

On March 20, when the rain and warm weather caused the river to back up behind the gorge, as described above, Doctor Barnes began using thermite near Brandon. The gorge finally yielded, as previously related.

This is believed to be the first time thermite has been used for the purpose in this country, a matter of historical interest.

Opinions as to the effectiveness of the thermite in breaking up the Franklin gorge differ widely. Pennsylvania Railroad Co. engineers believe that the use of thermite at the strategic points was responsible for a decided disintegration of the ice, which resulted in the final breakup. Others, who were in close contact with the use of both dynamite and thermite, are of the opinion that the ice would have gone out at the same time from natural causes and with no more damage to property if neither had been used.

THOMAS JEFFERSON ON THE CLIMATE OF VIRGINIA

In 1788 the firm of Prichard & Hall, in Market Street, between Front and Second Streets, Philadelphia, published Thomas Jefferson's "Notes on the State of Virginia." Through the kindness of Dr. H. C. Frankenfield we are able to reprint a portion of this fascinating old work, the only change in form being the use of the modern lower-case "s." Let Jefferson himself write the rest of this introduction:

The following Notes were written in Virginia in the year 1781, and somewhat corrected and enlarged in the winter of 1782, in answer to Queries proposed to the Author, by a Foreigner of Distinction, then residing among us. The subjects are all treated imperfectly; some scarcely touched on. To apologize for this by developing the circumstances of the time and place of their composition, would be to open wounds which have already bled enough. To these circumstances some of their imperfections may with truth be ascribed; the great mass to the want of information and want of talents in the writer. He had a few copies printed, which he gave among his friends: and a translation of them has been lately published in France, but with such alterations as the laws of the press in that country rendered necessary. They are now offered to the public in their original form and language.

Feb. 27, 1787. . . .

QUERY VII

A NOTICE of all that can increase the progress of human knowledge?

Under the latitude of this query, I will presume it not improper nor unacceptable to furnish some data for estimating the climate of Virginia. Journals of observations on the quantity of rain, and degree of heat, being lengthy, confused, and too minute to produce general and distinct ideas, I have taken five years' observations, to wit, from 1772 to 1777, made in Williamsburgh and neighbourhood, have reduced them to an average for every month in the year, and stated those averages in the following table, adding an analytical view of the winds during the same period.

	Fall of rain, &c. in inches.	Least & greatest daily heat by Farenheit's thermometer.		WINDS N.	N.E.	E.	S.E.	S.	S. W.	W.	N.W.	Total
Jan	3.192	38½ to	44	73	47	32	10	11	78	40	46	337
Feb	2.049	41	47½	61	52	24	11	4	63	30	31	276
March	3.95	48	54½	49	44	38	28	14	83	29	33	318
April	3.68	56	62½	35	44	54	19	9	58	18	20	257
May	2.871	63	70½	27	36	62	23	7	74	32	20	281
June	3.751	71½	78¼	22	34	43	24	13	81	25	25	267
July	4.497	77	82½	41	44	75	15	7	95	32	19	328
August	9.153	76¼	81	43	52	40	30	9	103	27	30	334
Sept	4.761	69½	74¼	70	60	51	18	10	81	18	37	345
Octo	3.633	61¼	66½	52	77	64	15	6	56	23	34	327
Nov	2.617	47¾	53½	74	21	20	14	9	63	35	58	294
Dec	2.877	43	48¾	64	37	18	16	10	91	42	56	334
Total	47.038	8 A. M.	4 P. M.	611	548	521	223	109	926	351	400	3698

The rains of every month, (as of January for instance) through the whole period of years, were added separately, and an average drawn from them. The coolest and warmest point of the same day in each year of the period were added separately, and an average of the greatest cold and greatest heat of that day, was formed. From the averages of every day in the month, a general average for the whole month was formed. The point from which the wind blew was observed two or three times in every day. These observations, in the month of January for instance, through the whole period amounted to 337. At 73 of these, the wind was from the North; at 47, from the North-east, &c. So that it will be easy to see in what proportion each wind usually prevails in each month: or, taking the whole year, the total of observations through the whole period having been 3698, it will be observed that 611 of them were from the North, 558 from the North-east, &c.

Though by this table it appears we have on an average 47 inches of rain annually, which is considerably more than usually falls in Europe, yet from the information I have collected, I suppose we have a much greater proportion of sunshine here than there. Perhaps it will be found there are twice as many cloudy days in the middle of Europe, as in the United States of America. I mention the middle parts of Europe, because my information does not extend to its northern or southern parts.

In an extensive country, it will of course be expected that the climate is not the same in all its parts. It is remarkable that, proceeding on the same parallel of latitude westwardly, the climate becomes colder in like manner as when you proceed northwardly. This continues to be the case till you attain the summit of the Alleghaney, which is the highest land between the ocean and the Missisipi. From thence, descending in the same latitude to the Missisipi, the change reverses; and, if we may believe travellers, it becomes warmer there than it is in the same latitude on the sea side. Their testimony is strengthened by the vegetables and animals which subsist and multiply there naturally, and do not on our sea coast. Thus Catalpas grow spontaneously on the Missisipi, as far as the latitude of 37° and reeds as far as 38°. Perroquets even winter on the Sioto, in the 39th degree of latitude. In the summer of 1779, when the thermometer was at 90° at Monticello, and 96 at Williamsburgh, it was 110° at Kaskaskia. Perhaps the mountain, which overhangs this village on the North side, may, by its reflexion, have contributed somewhat to produce this heat. The difference of temperature of the air at the sea coast, or on Chesapeak bay, and at the Alleghaney, has not been ascertained; but cotemporary observations, made at Williamsburgh, or in its neighbourhood, and at Monticello, which is on the most eastern ridge of mountains, called the South West, where they are intersected by the Rivanna, have furnished a ratio by which that difference may in some degree be conjectured. These observations make the difference between Williamsburgh and the nearest mountains, at the position before mentioned, to be on an average 6⅛ degrees of Farenheit's thermometer. Some allowance however is to be made for the difference of latitude between these two places, the latter being 38° 8′ 17″ which is 52′ 22″ North of the former. By cotemporary observations of between five and six weeks, the averaged and almost unvaried difference of the height of mercury in the barometer, at those two places, was .784 of an inch, the atmosphere at Monticello being so much the lightest, that is to say, about one-thirtyseventh of its whole

weight. It should be observed, however, that the hill of Monticello is of 500 feet perpendicular height above the river which washes its base. This position being nearly central between our northern and southern boundaries, and between the bay and Alleghaney, may be considered as furnishing the best average of the temperature of our climate, Williamsburgh is much too near the South-eastern corner to give a fair idea of our general temperature.

But a more remarkable difference is in the winds which prevail in different parts of the country. The following table exhibits a comparative view of the winds prevailing at Williamsburgh, and at Monticello. It is formed by reducing nine months observations at Monticello to four principal points, to wit, the North-east, South-east, South-west, and North-west; these points being perpendicular to, or parallel with our coast, mountains and rivers: and by reducing in like manner, an equal number of observations, to wit, 421 from the preceding table of winds at Williamsburgh, taking them proportionably from every point.

	N. E.	S. E.	S. W.	N. W.	Total.
Williamsburgh	127	61	132	101	421
Monticello	32	91	126	172	421

By this it may be seen that the South-west wind prevails equally at both places; that the North-east is, next to this, the principal wind towards the sea coast, and the North-west is the predominant wind at the mountains. The difference between these two winds to sensation, and in fact, is very great. The North-east is loaded with vapour, insomuch, that the salt-makers have found that their crystals would not shoot while that blows; it brings a distressing chill, is heavy and oppressive to the spirits: the North-west is dry, cooling, elastic and animating. The Eastern and South-eastern breezes come on generally in the afternoon. They have advanced into the country very sensibly within the memory of people now living. They formerly did not penetrate far above Williamsburgh. They are now frequent at Richmond, and every now and then reach the mountains. They deposit most of their moisture however before they get that far. As the lands become more cleared, it is probable they will extend still further westward.

Going out into the open air, in the temperate, and in the warm months of the year, we often meet with bodies of warm air, which, passing by us in two or three seconds, do not afford time to the most sensible thermometer to seize their temperature. Judging from my feelings, only, I think they approach the ordinary heat of the human body. Some of them perhaps go a little beyond it. They are of about 20 or 30 feet diameter horizontally. Of their height we have no experience, but probably they are globular volumes wafted or rolled along with the wind. But whence taken, where found, or how generated? They are not to be ascribed to volcanoes, because we have none. They do not happen in the winter when the farmers kindle large fires in clearing up their grounds. They are not confined to the spring season, when we have fires which traverse whole counties consuming the leaves which have fallen from the trees. And they are too frequent and general to be ascribed to accidental fires. I am persuaded their cause must be sought for in the atmosphere itself, to aid us in which I know of but these constant circumstances; a dry air; a temperature as warm at least as that of the spring or autumn; and a moderate current of wind. They are most frequent about sun-set; rare in the middle parts of the day; and I do not recollect having ever met with them in the morning.

The variation in the weight of our atmosphere, as indicated by the barometer, is not equal to two inches of mercury. During twelve months observation at Williamsburgh, the extremes were 29, and 30.86 inches, the difference being 1.86 of an inch; and in nine months, during which the height of mercury was noted at Monticello, the extremes were 28.48 and 29.69 inches, the variation being 1.21 of an inch. A gentleman, who has observed his barometer many years, assures me it has never varied two inches. Cotemporary observations, made at Monticello and Williamsburgh, proved the variations in the weight of air to be simultaneous and corresponding in these two places.

Our changes from heat to cold, and cold to heat, are very sudden and great. The mercury in Farenheit's thermometer has been known to descend from 92° to 47° in thirteen hours.

It is taken for granted, that the preceding table of average heat will not give a false idea on this subject, as it proposes to state only the ordinary heat and cold of each month, and not those which are extraordinary. At Williamsburgh in August 1766, the mercury in Farenheit's thermometer was at 98° corresponding with 29⅓ of Reaumur. At the same place in January 1780, it was 6° corresponding with 11⅓ below 0 of Reaumur. I believe these may be considered to be nearly the extremes of heat and cold in that part of the country. The latter may most certainly, as, at that time, York river, at York town, was frozen over, so that people walked across it; a circumstance which proves it to have been colder than the winter of 1740, 1741, usually called the cold winter, when York river did not freeze over at that place. In the same season of 1780, Chesapeak bay was solid, from its head to the mouth of the Patowmac. At Annapolis, where it is 5¼ miles over between the nearest points of land, the ice was from 5 to 7 inches thick quite across, so that loaded carriages went over on it. Those, our extremes of heat and cold, of 6° and 98° were indeed very distressing to us, and were thought to put the extent of the human constitution to considerable trial. Yet a Siberian would have considered them as scarcely a sensible variation. At Jenniseitz in that country, in latitude 58° 27′ we are told, that the cold in 1735 sunk the mercury by Farenheit's scale to 126° below nothing; and the inhabitants of the same country use stove rooms two or three times a week, in which they stay two hours at a time, the atmosphere of which raises the mercury to 135° above nothing. Late experiments show that the human body will exist in rooms heated to 140° of Reaumur, equal to 347° of Farenheit's, and 135° above boiling water. The hottest point of the 24 hours is about four o'clock, P. M. and the dawn of day the coldest.

The access of frost in autumn, and its recess in the spring, do not seem to depend merely on the degree of cold; much less on the air's being at the freezing point. White frosts are frequent when the thermometer is at 47° have killed young plants of Indian corn at 48° and have been known at 54°. Black frost, and even ice, have been produced at 38½° which is 6½° above the freezing point. That other circumstances must be combined with the cold to produce frost, is evident from this also, that on the higher parts of mountains, where it is absolutely colder than in the plains on which they stand, frosts do not appear so early by a considerable space of time in autumn, and go off sooner in the spring than in the plains. I have known frosts so severe as to kill the hiccory trees round about Monticello, and yet not injure the tender fruit blossoms then in bloom on the top and higher parts of the mountain; and in the course of 40 years, during which it has been settled, there have been but two instances of a general loss of fruit on it; while in the circumjacent country, the fruit have escaped but twice in the last seven years. The plants of tobacco, which grow from the roots of those which have been cut off in the summer, are frequently green here at Christmas. This privilege against the frost is undoubtedly combined with the want of dew on the mountains. That the dew is very rare on their higher parts, I may say with certainty, from 12 years observations, having scarcely ever, during that time, seen an unequivocal proof of its existence on them at all during summer. Severe frosts in the depth of winter prove that the region of dews extends higher in that season than the tops of the mountains; but certainly, in the summer season, the vapours, by the time they attain that height, are become so attenuated as not to subside and form a dew when the sun retires.

The weavil has not yet ascended the high mountains.

A more satisfactory estimate of our climate to some, may perhaps be formed, by noting the plants which grow here, subject however to be killed by our severest colds. These are the fig, pomegranate, artichoke, and European walnut. In mild winters, lettuce and endive require no shelter; but generally they need a slight covering. I do not know that the want of long moss, reed, myrtle, swamp laurel, holly and cypress, in the upper country, proceeds from a greater degree of cold, nor that they were ever killed with any degree of cold in the lower country. The aloe lived in Williamsburgh in the open air through the severe winter of 1779, 1780.

A change in our climate however is taking place very sensibly, heats and colds are become much more moderate within the memory even of the middle-aged. Snows are less frequent and less deep. They do not often lie, below the mountains, more than one, two, or three days, and very rarely a week. They are remembered to have been formerly frequent, deep, and of long continuance. The elderly inform me that the earth used to be covered with snow about three months in every year. The rivers, which then seldom failed to freeze over in the course of the winter, scarcely ever do so now. This change has produced an unfortunate fluctuation between heat and cold, in the spring of the year, which is very fatal to fruits. From the year 1741 to 1769, an interval of twenty-eight years, there was no instance of fruit killed by the frost in the neighbourhood of Monticello. An intense cold, produced by the constant snows, kept the buds locked up till the sun could obtain, in the spring of the year, so fixed an ascendancy as to dissolve those snows, and protect the buds, during their development, from every danger of returning cold. The accumulated snows of the winter remaining to be dissolved all together in the spring, produced those overflowings of our rivers, so frequent then, and so rare now.

The answer to QUERY VII then closes with a detailed description of the phenomenon of *looming* as it affected distant hills visible from Monticello.

NOTES, ABSTRACTS, AND REVIEWS

TWO SEASONAL RAINFALL FORECASTS FOR CALIFORNIA

Readers of the REVIEW will recall that in the November, 1925, issue we published the results of two investigations into the possibility of forecasting, on the basis of certain summer conditions, what the precipitation in the next following rainy season would be over California.

McEwen presented his computed and observed seasonal rainfalls for 7 groups of stations in central and southern California, and found that for each group a negative correlation was indicated between summer temperature of the surface waters of the Pacific Ocean off the California coast and the ensuing season's rainfall. The extent to which the computations of seasonal rainfalls have been borne out by the event, during the period 1916–17 to 1924–25, is most encouraging. It may be viewed in the following ways.

(1) There has been a rough numerical agreement between computed and observed values, over 75 per cent of the errors being of 2 inches or less.

(2) There has been agreement between the signs of computed and observed departures of precipitation from the nine-year normal, about 80 per cent of the time.

(3) In 56 computed versus observed trends of rainfall from one season to the next (7 groups of stations for 8 seasonal differences), there has been disagreement but eight times, indicating agreement in trend in 85 per cent of the cases.

McEwen's computed departures for the 1925–26 season (7 groups of stations) indicated rainfall in excess of normal by amounts ranging from 0.4 inch to 1.2 inch according to the group. Rainfall records for southern California to April 23 show that: The sign of the computed departure is already borne out by the event; the computed excess falls short of the actual excess; the actual trend since the 1924–25 season, while it is the reverse of the trend which results from considering the computed values for 1924–25 and 1925–26, agrees with the trend from the observed rainfall of the former season to the computed rainfall of the latter.

Blochman, from a comparison of certain pressure and rainfall conditions during summer and early autumn with the ensuing season's rainfall for central and southern California, arrived at several conclusions of which the following seem most pertinent to quote here:

(1) It is almost a certainty (better than a 90 per cent probability) that when South Pacific LOWS enter south of Cape Mendocino in either September or October, the ensuing season, especially for southern California, will be average to wet. This high percentage does not hold good for northern California, but it does for central California.

(2) Assuming 0.21 inch to be an "average" summer rainfall at San Diego, the tabulation shows that 19 seasons out of the 21 that had average or more than average summer rains preceded average to wet seasons in southern California. But * * * when we consider only the appreciable summer rains at San Diego due to LOWS that came in from the Pacific, *there are 19 seasons out of 20 that preceded average to wet seasons in southern California.*

In the first week of October, 1925, San Diego experienced a rainfall of some 3½ inches, from a LOW that appears to have developed close to or over the adjacent coast. The total excess of rainfall for the month was 3.2 inches. Discussing this event in the Berkeley Gazette for October 9, 1925, Blochman pointed out its probable bearing on the coming season's rainfall, and concluded that: "There is no reason why this season should be an exception to the rule, especially as it has the greatest early rainfall recorded."

In view of these advance estimates by both McEwen and Blochman of what the 1925–26 rainfall season would bring forth, the rainfall at five representative stations in southern and central California from July 1, 1925, to April 23, 1926, compared with the *normal seasonal total*, is of interest:

	San Diego	Los Angeles	Fresno	San Francisco	Sacramento
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
To Apr. 23, 1926	15.56	17.36	9.28	20.45	15.61
Normal seasonal total to June 30	9.70	15.62	9.82	22.52	18.56

—*B. M. Varney.*

TORNADO REPORTED FROM NORTHWESTERN OREGON

It is very rarely that tornadoes occur in the Pacific Coast States. Mr. W. J. Kelley, of McMinnville, Oreg., has sent to the Weather Bureau a report of what appears to have been a small tornado that damaged his farm on February 19, 1926. The account, together with photographs accompanying it, indicates the occurrence of winds which were certainly of tornadic violence, which felled many trees; the same storm destroyed a large "dry house" about a mile southwest of Mr. Kelley's farm. It is stated there was no lightning, thunder, nor hail with the storm, though it rained heavily for a short time. A friend of Mr. Kelley told him that "there seemed to be four or five little whirlwinds in a bunch coming down from one big and very black cloud and whirling around with great speed."—*B. M. V.*

RELATIONS BETWEEN THE TEMPERATURES, PRESSURES, AND DENSITIES OF GASES

Under the above title the Bureau of Standards of the U. S. Department of Commerce has published its Circular No. 279, by Mr. S. F. Pickering, associate chemist of the bureau. The author's abstract follows:

The attempt has been made, in discussing the relations between the temperatures, pressures, volumes, and weights of gases, to derive the formulas in a simple manner with the minimum requirements of theoretical knowledge on the part of the reader. The experimental data involving high pressures are presented in such a form that problems of this nature can be easily solved by introducing factors taken directly from the curves. The significance of the equations of state of van der Waals, of Dieterici, and of Berthelot are discussed, and the manner in which these quotations may be used to predict compressibilities is explained in detail. Comparisons of the calculated values with the experimental data for various gases are shown by means of a series of curves. There is included a rather extensive bibliography of the literature pertaining to the subjects herein discussed, together with a number of tables of conversion factors and equivalents.

THE EDGE OF THE DOLDRUMS

C. E. P. Brooks in the Meteorological Magazine for March, 1926, presents results of a study of the relation between rainfall and wind direction and constancy of direction at Malden and Ocean Islands, both of them close to the Equator and both under the influence of the trade winds. The uniformity of their ocean environment would lead one to expect winds of whatever direction to be of not greatly differing constitution in respect to temperature and relative humidity, which is indeed the case of the surface winds. But out of 72 months of record (in *Reseau Mondial*), 32 months in which wind directions averaged more than 60° from North and in

which the constancy[1] of the wind was more than 70 per cent, included only one month with rainfall in excess of 100 millimeters; while of the remaining 40 months (having directions within 60° of north) all but one showed more than 100 millimeters.

At Malden Island, the months with north or northeast wind had nearly five times as much rainfall as those with east and southeast. At Ocean Island, the months with resultant winds between 65° and 120° had only about one fifth of the rain that months with winds from other directions had.

A very clear relation exists between constancy of wind direction and rainfall; the greater the constancy during a given month, the less the contemporaneous rainfall. Thus at Malden Island the correlation between the two is −0.73; at Ocean Island it is −0.72, which becomes −0.76 if a single month which had heavy rainfall with northeast wind (April, 1919) be excepted.

Tables are presented showing that the apparent dryness of winds from east and southeast is due largely, but by no means entirely, to their greater constancy. In other words, in this region of the equatorial Pacific, conflicting wind directions seem to be the greatest source of rain. The existence of these conflicting directions may be taken to indicate a zone of eddy motion in the atmosphere at the edge of the doldrums.—*B. M. V.*

AUSTRALIAN WINDSTORMS

A discussion on Australian hurricanes and related storms, with an appendix on hurricanes in the South Pacific, prepared by Mr. Stephen S. Visher of Indiana University and Mr. D. Hodge of the Bureau of Meteorology, Melbourne, has been issued under the direction of Mr. H. A. Hunt, Commonwealth meteorologist (Bull. No. 16, Bureau of Meteorology, Melbourne). The publication has been undertaken that all recorded data regarding the occurrence of hurricanes in Australia and the surrounding tropical waters might be available for the information of mariners and shipping interests generally. In Australia the Queensland coast is most often affected by hurricanes. In the 34 years 1890–1923 they averaged one or two a year, coupled annually with two or three storms of less severity. Four-fifths of the storms occur in the five months December to April, and two-thirds of the storms occur in January, February, and March. Most of the hurricanes which affect Queensland come from the east; many recurve near the coast and pass southward, frequently as far as Brisbane. Western Australia has, on the average, rather more than one hurricane a year. In the 52 years 1872–1923, 74 severe tropical cyclones were recorded; some years had as many as three, and one year, 1917, had five. Of the less severe types of storm, Western Australia has fewer than Queensland. The portion of Western Australia which is most frequently damaged by hurricanes lies far north of Perth. The hurricanes are most frequent in the hotter months. The Northern Territory has fewer cyclones than Queensland or Western Australia. Attempts have been made to issue long-previous predictions of hurricanes but no satisfactory result has been attained. Maps are given showing the hurricane season in different parts of Australia and the movements of the hurricanes at different seasons of the year. *Nature*, (London), *February 20, 1926*.

[1] "The resultant direction and 'constancy' are computed as follows: Each observation of direction is regarded as a unit vector and the resultant direction is obtained by compounding the unit vectors. The 'constancy' is represented by 100 times the ratio of the vector sum of the unit vectors to the number of observations (calms included). Direction is specified by the azimuth of the point from which the wind is blowing, and is measured in degrees from north through east."

METEOROLOGICAL SUMMARY FOR SOUTHERN SOUTH AMERICA, FEBRUARY, 1926

By Señor J. B. NAVARRETE

[El Salto Observatory, Santiago, Chile]

February was characterized by a rather stable atmospheric régime, continuing the hot period in the central zone of Chile. During the entire first decade the anticyclonic center dominated the south, with general fine weather, high temperatures and prevailingly southerly winds, which were rather heavy between the coasts of Chiloe and Arauco Provinces.

On the 12th, it rained in Chiloe, Haufo, and Raper, and on the 13th light rains extended as far at Valdivia, the most important fall being 8 millimeters at Cabo Raper.

On the 18th and 19th pressure rose in the south; on the 20th the center of the high pressure was located off Valdivia, and it rained from this point south. On the 22d the change of weather affected the central zone of Chile, with light rains and a smart fall of temperature.

From the 23d to 25th, pressure rose in the south, forming a high pressure center in the interior of the continent, with the highest pressure at Neuquen in the Argentine.

During the later days of the month, 26, 27 and 28, an important depression overlay the southern part of the continent, causing rains between Malleco and Magallanes; maximum precipitation was 20 millimeters at Cabo Raper.

At Valdivia, one of the rainiest regions of Chile, only 59.5 millimeters fell during February.—*Translation by B. M. V.*

METEOROLOGICAL SUMMARY FOR BRAZIL, FEBRUARY, 1926

By J. de SAMPAIO FERRAZ

[The Meteorological Office, Rio de Janeiro]

Circulation as expressed by the number of HIGHS and LOWS was slightly weaker in the month of February. Four anticyclones visited the country and although their tracks continued abnormal as of late, most of them affected northern Argentine and Matto Grosso, sending cold air to the far north, causing very likely, as we think, larger rainfall in those regions. The continental depression and the migratory LOWS of the extreme south were less active.

Rainfall was generally abundant in the north and center and below normal in the south with the exception Rio de Janeiro State and scattered points. Big floods occurred in the San Francisco River. Rio Grande do Sul continued with droughty conditions, which as explained, were caused by smaller activity of low-pressure areas and tracks of the anticyclones.

The weather in Rio de Janeiro was slightly unsettled, but with little rain. Temperature continued abnormally low, closing the summer season with an exceptionally cool month. Southerly winds were prevalent, but generally moderate.

Crops generally did well except in Rio Grande do Sul, where they suffered on account of lack of precipitation.

DR. DE SAMPAIO FERRAZ

We regret to learn of the temporary retirement of Doctor Ferraz from the directorship of the Brazilian Meteorological Service due to continued ill-health and the necessity of refraining from the onerous administrative duties of that position for several months or longer.—*A. J. H.*

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SOLAR OBSERVATIONS

SOLAR AND SKY RADIATION MEASUREMENTS DURING MARCH, 1926

By HERBERT H. KIMBALL, Solar Radiation Investigations

For a description of instruments and exposures and an account of the method of obtaining and reducing the measurements, the reader is referred to the REVIEW for January, 1924, **52**: 42, January, 1925, **53**: 29, and July, 1925, **53**: 318.

From Table 1 it is seen that solar radiation intensities averaged above March normals at all three stations. At Washington, a noon reading of 1.53 gr. cal./min./cm.^{2} on the 5th, is 3½ per cent higher than any intensity heretofore measured at that station in March, and 1⅓ per cent higher than the maximum that has been measured in any month.

Table 2 shows that the total solar and sky radiation received on a horizontal surface averaged above the March normal at all three stations, and decidedly above at Washington and Madison.

Skylight polarization measurements were not made at Madison on account of the presence of snow on the ground during nearly the entire month. At Washington, measurements made on six days give a mean of 61 per cent with a maximum of 66 per cent on the 5th. These are above the average March values for Washington.

TABLE 1.—*Solar radiation intensities during March, 1926*

[Gram-calories per minute per square centimeter of normal surface]

Washington, D. C.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	78th mer. time	Air mass, A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Mar. 2	3.63				1.30						1.52
4	1.52			0.99	1.18						1.78
5	1.24		0.99	1.10	1.35	1.66	1.35	1.10	0.96	0.91	1.19
6	2.16		0.79	0.82	1.00						2.16
16	3.00		0.59								1.96
17	2.36		0.59	0.79	1.13	1.54	1.23				2.16
22	4.37	0.75	0.86	1.04	1.20						4.57
24	4.57	0.71	0.92	1.08	1.25	1.43	1.27	1.05			3.99
25	6.27		0.77	0.89							6.76
29	3.81	0.63	0.77	0.95	1.08	1.21					2.62
30	4.37		0.88		1.00						3.45
Means		0.70	0.80	0.96	1.17	1.46	1.28	(1.08)	(0.96)	(0.91)	
Departures		−0.01	±0.00	+0.02	+0.02	+0.02	+0.16	+0.14	+0.16	+0.22	

[1] Extrapolated.

TABLE 1.—*Solar radiation intensities during March, 1926*—Contd.

Madison, Wis.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	78th mer. time	Air mass, A. M.					P. M.				Local mean solar time
	e.	5.0	4.0	3.0	2.0	[1] 1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Mar. 2	1.02					1.40	1.31				1.19
3	1.02	1.02	1.14		1.42	1.61					1.52
4	1.45			1.23	1.39	1.55	1.40				1.68
8	1.19			0.90			1.42				1.37
9	2.26		1.10	1.24	1.40	1.58	1.42	1.20			3.15
13	0.96				1.43	1.59	1.42	1.24			1.15
16	2.74						1.38				3.78
23	4.17		1.06	1.19	1.32	1.44					4.95
29	2.74					1.55	1.34				2.74
Means		(1.02)	1.10	1.14	1.39	1.53	1.38	(1.22)			
Departures		+0.05	+0.06	−0.04	+0.07		+0.08	+0.05			

Lincoln, Neb.

Date	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
Mar. 1	3.00	1.06	1.14	1.26		1.42	1.34				2.16
2	2.16	1.02	1.13	1.32	1.47	1.64	1.43	1.27	1.12	0.99	1.68
3	1.96	0.81	0.90	1.07	1.24	1.35	1.35	1.10	1.01	0.92	2.62
4	2.62			0.78	0.98						3.00
8	1.96		1.10	1.19	1.30		1.38	1.13			2.74
11	3.30		0.78	1.02	1.22	1.46					5.36
13	1.78			1.08							1.96
15	2.74		1.17	1.28			1.41	1.19	1.10	0.99	3.00
16	3.30	0.95	1.10	1.24	1.39	1.57	1.38	1.21	1.07	0.96	4.95
17	3.45	0.85	0.92	1.08	1.28	1.52					7.57
20	3.81		0.82		1.23		1.29	1.06	0.88		3.81
22	5.36					1.58	1.33	1.16	0.99		3.63
23	4.17	0.79		1.01	1.17						4.17
26	1.88					1.58	1.37	1.22	1.08	0.97	1.78
31	1.88					1.49	1.27	1.07	0.93	0.84	1.88
Means		0.91	1.01	1.12	1.25	1.51	1.36	1.16	1.02	0.94	
Departures		+0.02	+0.06	+0.03	−0.04		+0.07	+0.07	+0.08	+0.12	

TABLE 2.—*Solar and sky radiation received on a horizontal surface*

[Gram-calories per square centimeter of horizontal surface]

Week beginning—	Average daily radiation					Average daily departure from normal		
	Washington	Madison	Lincoln	Chicago	New York	Washington	Madison	Lincoln
1926	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Feb. 26	348	350	418	112	214	+60	+86	+80
Mar. 5	350	288	301	115	207	+44	+2	−59
12	382	375	382	134	248	+49	+72	−3
19	382	261	432	154	246	+16	−50	+15
26	351	329	421	88	269	−12	−8	−7
Deficiency since first of year on Apr. 1						−91	−1,561	−2,009

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS

NORTH ATLANTIC OCEAN

By F. A. YOUNG

The unusually stormy weather of the last five months continued during March over the greater part of the North Atlantic. The maximum number of days with winds of gale force occurred in the 5-degree square between the fortieth and forty-fifth parallels and the fortieth and forty-fifth meridians, where they were reported on nine days. Very unfavorable conditions also existed over a large portion of the region between the Azores and Bermudas, and along the American coast, between Nantucket and Florida. In the former region gales were reported on from four to five days, and in the latter, from six to seven days. The frequency of gales over the middle section of the steamer lanes was apparently not far from the normal as shown on the Pilot Chart, while over the section east of the twentieth meridian, the winds were comparatively moderate.

The number of days with fog was considerably less than usual over the Grand Banks, the steamer lanes and off the British coast; they were about normal off the American coast, and considerably above in the Gulf of Mexico, where fog was observed on four days.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressures at sea level, 8 a. m. (seventy-fifth meridian), North Atlantic Ocean, March, 1926*

Stations	Average pressure	Departure [1]	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
St. Johns, Newfoundland	29.72	−0.13	30.24	2d [2]	29.18	26th.[2]
Nantucket	29.92	−0.08	30.54	6th	29.22	24th.
Hatteras	30.04	+0.01	30.56	do	29.48	26th.
Key West	30.08	+0.05	30.26	15th [2]	29.82	26th.
Swan Island	29.99	−0.06	30.04	8th	29.74	26th.
New Orleans	30.10	+0.07	30.38	14th	29.56	30th.
Turks Island	30.08	+0.06	30.18	6th [2]	29.92	24th.
Bermuda	30.09	+0.06	30.46	1st	29.48	12th.
Horta, Azores	30.14	+0.02	30.66	4th	29.22	31st.
Lerwick, Shetland Islands	29.77	+0.07	30.50	20th	28.95	29th.
Valencia, Ireland	30.09	+0.19	30.66	11th	29.43	28th.
London	30.07	+0.11	30.54	1st	29.44	27th.

[1] From normals shown on H. O. Pilot Chart, based on observations at Greenwich mean noon, or 7 a. m., 75th meridian.
[2] And on other dates.

While the average pressure for the month at Horta was nearly normal, the average for the first decade was 30.40 inches, the second 30.12 inches, and for the last 11 days 29.89 inches.

From the 1st to 3d there was a depression off the south coast of Iceland and moderate westerly to southwesterly gales prevailed over the middle and eastern sections of the steamer lanes. On the 4th the center of this disturbance was near the north coast of Scotland; land stations on the British Isles, as well as vessels in the vicinity, reported westerly gales, while on the 3d and 4th the conditions in mid-ocean were about the same as on the first two days of the month.

On the 2d, New York was near the center of a LOW that moved northeastward along the coast, and on the 4th the center was in the vicinity of St. Johns, Newfoundland, while on the 3d and 4th northwesterly gales occurred in the southwesterly quadrants.

On the 5th and 6th comparatively quiet weather was the rule over the ocean except that on the latter date there was a area of unusually high pressure central near Norfolk, with a crest of 30.62 inches, and vessels in the vicinity of the Bermudas reported northerly winds of gale force, accompanied by barometric readings of from 30.20 to 30.26 inches. During the next 24 hours the pressure in this region fell rapidly, and on the 7th the barometer at Norfolk read 29.92 inches. The anticyclonic storm area of the 6th was now central near 40° N., 53° W., where northeasterly winds, force 8, prevailed, with barometric readings of over 30.20 inches.

On the 8th, the center of a well-developed LOW was near Father Point and strong gales prevailed between the thirtieth and fiftieth parallels, west of the sixtieth meridian. On this date there was also a disturbance of less extent and intensity off the west coast of Ireland.

By the 9th the western LOW was over the Gulf of St. Lawrence, and a number of vessels in the southwestern section of the ocean encountered moderate gales, while conditions over the British Isles had changed but little since the previous day. The western disturbance apparently curved sharply southward, as on the 10th the center was near 40° N., 55° W., and vessels between the thirtieth and forty-fifth parallels and fiftieth and seventieth meridians encountered gales, although a number of ships in the same region experienced moderate weather. This LOW developed into a very severe and protracted disturbance, as shown on Charts VIII to XIII that cover the period from the 11th to 16th, inclusive. These charts also show the disturbance along the American coast that reached its maximum force on the 14th.

By the 17th the main disturbance had contracted slightly in extent, although strong gales still prevailed over the steamer lanes between the twenty-fifth and fiftieth meridians, and moderate gales in the vicinity of Hatteras.

From the 19th to 21st there was a secondary LOW over the region between the Azores and the forty-fifth meridian, surrounded by a well-defined storm area. On the 19th and 20th stormy weather was also encountered over the middle section of the steamer lanes, which by the 21st had moderated considerably.

From the 22d to 25th a period of favorable weather ensued over practically the entire ocean, although on the former date the Belgian steamship *Carlier*, as shown in storm report, reported a northerly wind, force 9, in the region between the Bermudas and Nantucket, although other vessels in the vicinity encountered only moderate weather.

On the 25th there was a deep depression over the Gulf of St. Lawrence, surrounded by comparatively light winds.

On the 26th Hatteras was near the center of a LOW that moved northeastward along the coast, and on the 27th was in the vicinity of Newfoundland, where it remained nearly stationary during the remainder of the month. Comparatively moderate weather prevailed along the American coast during this period, although on the 29th moderate to strong westerly gales occurred over a limited area between the thirty-fifth and forty-fifth parallels and fiftieth and sixtieth meridians. By the 30th this storm had increased both in extent and intensity and westerly to northwesterly winds of hurricane force were encountered over the steamer lanes between the thirtieth and forty-fifth parallels and fortieth and sixtieth meridians.

On the 26th and 27th there was a LOW of limited extent over the middle section of the steamer lanes, accompanied by moderate gales in the westerly and southerly quadrants.

On the 30th there was a depression central near 47° N., 27° W., that afterwards developed into a very severe disturbance that moved slowly eastward, reaching the British coast early in April. By the 31st this LOW had moved but little, but had increased in intensity, with minimum barometric readings of 28.50 inches, the storm area covering the greater part of the region between the thirtieth and sixtieth parallels and the twentieth and sixtieth meridians.

OCEAN GALES AND STORMS, MARCH, 1926

Vessel	Voyage		Position at time of lowest barometer		Gale began	Time of lowest barometer	Gale ended	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Highest force of wind and direction	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				Inches					
München, Ger. S. S.	New York	Queenstown	42 30 N.	43 30 W.	1st	4p., 1st	2d	30.03	SSE	WSW., 7	WNW	NW., 9	S.-SW.-NW.
Cameronia, Br. S. S.	Glasgow	New York	51 34 N.	26 56 W.	1st	6a., 2d	2d	29.80	SW	SW., 8	SW	SW., 8	Steady.
Braga, Fr. S. S.	Lisbon	Providence	39 48 N.	65 55 W.	3d	8a., 3d	3d	29.51	SW	NW., 10	NW	NW., 10	SSW.-NW.
Maryland, Br. S. S.	Newport News.	Rotterdam	49 30 N.	9 19 W.	3d	9p., 3d	4th	29.86	W	W., 8	NW	W., 9	W.-NW.
Bellflower, Am. S. S.	Glasgow	Boston	52 02 N.	35 10 W.	4th	2p., 4th	5th	29.90	SSW	SSW., 7		SSW., 8	SSW.-SW.
Caracas, Am. S. S.	La Guayra	New York	29 27 N.	7 02 W.	5th	5p., 5th	6th	30.20	NNE	N., 8	NNE	NNE., 8	Steady.
Bellepine, Am. S. S.	Antwerp	Philadelphia	37 17 N.	51 30 W.	6th	9p., 6th	7th	29.85	NE	NE., 7	N	NE., 9	S.-NW.
Satanta, Br. S. S.	Tampico	New York	36 30 N.	74 45 W.	6th	10p., 7th	7th	29.59	NE	WSW., 6	WNW	SW., 9	SW.-NW.
Bilderdijk, Du. S. S.	Newport News.	Rotterdam	38 42 N.	65 30 W.	7th	9a., 8th	8th	29.45	S	SSW., 10	WNW	SSW., 10	SSW.-W.
Regina, Br. S. S.	Liverpool	New York	54 48 N.	12 33 W.	7th	Noon, 8th	9th	29.63	SW	SW., —	WNW	NNW., 9	SSW.-WNW.
Emanuel Nobel, Belg. S. S.	Port Arthur	Genoa	30 05 N.	70 45 W.	9th	7p., 9th	10th	30.02	WNW	WNW., 8	NNW	—, 10	
Bilderdijk, Du. S. S.	Newport News.	Rotterdam	39 50 N.	53 06 W.	10th	6p., 10th	12th	29.26	NE	NE., 7	W	N., 10	NE.-NNW.
Emanuel Nobel, Belg. S. S.	Port Arthur	Genoa	31 21 N.	60 03 W.	11th	6a., 11th	12th	29.68	SSW	SSW., 10	WSW	—, 12	
Coldwater, Am. S. S.	Wilmington, N. C.	Liverpool	46 00 N.	34 15 W.	11th	10p., 11th	12th	29.36	SE	SE., 7	SW	SE., 10	SE.-SW.
Ida, Ital. S. S.	Norfolk	Gibraltar	39 26 N.	56 04 W.	12th	2p., 12th	13th	29.15	E	NNW., 7	NW	NNW., 10	
Emergency Aid, Am. S. S.	Rotterdam	Tampa	41 45 N.	27 54 W.	12th	Noon, 12th	12th	29.82	SE	SE., 10	SSW	SE., 10	SE.-SSW.
Porto Rico, Am. S. S.	New York	Vera Cruz	32 58 N.	76 13 W.	13th	Noon, 13th	14th	29.80	W	W., —	NNW	—, 12	W.-WSW.-NW
Nobles, Am. S. S.	Gibraltar	New York	34 30 N.	49 30 W.	13th	4p., 13th	13th	29.40	S	SSW., 10	NW	S., 12	S.-SSW.
Cripple Creek, Am. S. S.	Galveston	Liverpool	43 07 N.	42 40 W.	7th	6p., 13th	17th	28.63	SSW	W., 12	W	W., 12	S.-W.
Nobles, Am. S. S.	Gibraltar	New York	34 50 N.	54 00 W.	14th	4p., 14th	16th	29.47	S	SSW., 8	SW	W., 12	SSW.-SW.
Ida, Ital. S. S.	Norfolk	Gibraltar	40 20 N.	47 00 W.	14th	10a., 14th	15th	28.91	S	SW., 11	W	W., 12	
Hampton Roads, Am. S. S.	Venezuela	New York	34 00 N.	73 53 W.	15th	7p., 15th	15th	30.00	NW	NW., 9	NW	NW., 9	
Masconomo, Ger. S. S.	Port Arthur	Dunkirk	40 20 N.	47 00 W.	14th	4a., 15th	16th	28.84	S	SW., 11	NW	W., 12	SW.-WNW.
Sarcoxie, Am. S. S.	New York	Bordeaux	40 55 N.	44 00 W.	14th	6a., 15th	15th	29.30	S	SW., 11	NW	SW., 12	S.-SW.-NW.
Belgier, Belg. S. S.	RiodeJaneiro.	Galveston	29 06 N.	65 09 W.	17th	8p., 17th	18th	29.95	W	WNW., 9	N	NW., 10	W.-NW.
De Grasse, Fr. S. S.	Havre	New York	45 17 N.	46 46 W.	17th	8a., 17th	17th	29.09	SE	W., 12	WNW	W., 12	SE.-W.-N.
Clearpool, Br. S. S.	Gibraltar	Philadelphia	33 47 N.	53 30 W.	18th	3a., 18th	18th	29.55	W	NW., 12	N	NW., 12	W.-NW.-N.
Adalia, Ger. S. S.	Amsterdam	Habana	33 01 N.	43 06 W.	18th	6p., 18th	19th	29.53	SW	SW., 10	NNW	WSW., 11	SW.-NNW.
Lucellum, Br. S. S.	New York	Dublin	42 38 N.	43 02 W.	19th	2a., 19th	21st	29.45	SE	SSE., 12	NNW	SSE., 12	SE.-NNW.
Bird City, Am. S. S.	Copenhagen	Boston	53 48 N.	38 05 W.	18th	6a., 19th	20th	28.88	SE	SW., 10	W	—, 10	
Daytonian, Br. S. S.	Liverpool	do	44 11 N.	41 08 W.	20th	2a., 20th	20th	29.49	E	E., 10	N	—, 10	ENE.-N.
Carlier, Belg. S. S.	Antwerp	New York	37 10 N.	68 18 W.	22d	8a., 22d	22d	29.75	N	N., 9	NNE	—, 9	N.-W.-NNE.
Balsam, Am. S. S.	Belfast	do	37 11 N.	65 34 W.	26th	10p., 26th	27th	29.40	S	S., —	NW	S., 9	S.-NW.
River Delaware, Br. S. S.	New York	Gibraltar	39 13 N.	23 20 W.	29th	1a., 29th	29th	29.48	W	NW., 8	NW	W., 8	W.-NW.-WNW.
France, Fr. S. S.	Plymouth	New York	41 10 N.	56 20 W.	29th	6p., 29th	30th	29.33	W	W., 8	WNW	WNW., 9	W.-WNW.
River Orontes, Br. S. S.	Antwerp	Philadelphia	41 00 N.	53 00 W.	30th	4a., 30th	31st	29.39	WNW	WNW., —	NNW	—, 10	W.-NW.
Dakarian, Br. S. S.	Philadelphia	Liverpool	46 43 N.	32 54 W.	31st	3p., 31st	Apr. 1st	28.73	NW	W., 7	SW	NW., 9	NW.-W.
City of Fairbury, Br. S. S.	Hamburg	Galveston	42 08 N.	26 02 W.	31st	Noon, 31st	Apr. 6th	28.99	SW	SW., 9	S	NW., 9	SW.-W.
NORTH PACIFIC OCEAN													
West Ivan, Am. S. S.	San Francisco.	Yokohama	34 20 N.	151 30 E.	1st	10p., 1st	2d	29.75	S	S., 8	WNW	S., 8	S.-W.-WNW.
Hanley, Am. S. S.	Everett, Wash.	Balboa	14 26 N.	96 06 W.	2d	2p., 2d	3d	29.86	NE	NNE., 9	N	NNE., 9	NE.-N.
Talabot, Nor. S. S.	Yokohama	Vancouver	40 22 N.	156 26 E.	3d	Noon	3d	29.32	E	ENE., 8	NNW	E., 9	ENE.-N.
Iwatesan Maru, Jap. S. S.	do	San Francisco.	47 30 N.	160 45 W.	4th	9a., 5th	6th	29.10	SE	S., 8	SW	S., 8	ESE.-S.-SSW.
Koyu Maru, Jap. S. S.	Miike, Japan.	Grays Harbor.	51 30 N.	157 35 W.	7th	2a., 8th	9th	28.55	SE	W., 10	W	W., 10	NNE.-NW.-W.
Levant Arrow, Am. S. S.	Cebu	San Francisco.	35 18 N.	179 16 E.	6th	12a., 9th	12th	29.75	WNW	SW., 8	N	N., 10	S.-SW.
Ixion, Br. S. S.	Vancouver	Yokohama	40 19 N.	148 01 E.	10th	2p., 11th	12th	28.61	ESE	NW., 9	NW	NW., 10	SW.-W.-NW.
West Hixton, Am. S. S.	Astoria	Fushiki, Japan.	44 N.	148 E.	11th		12th	28.73	SE	SE., —	NW	NNW., 12	SE.-E.-NW.
Las Vegas, Am. S. S.	Columbia R.	Nagoya, Japan.	42 01 N.	149 55 E.	11th	8p., 11th	13th	28.48	E	SW., 7	NW	—, 12	8 pts.
Hokkai Maru, Jap. S. S.	Vancouver	Yokohama	48 34 N.	159 53 E.	12th	4p., 12th	14th	28.66	S	SE., 4	NNE	ENE., 11	ENE.-SE.
West Faralon, Am. S. S.	San Francisco.	do	33 57 N.	143 E.	14th	11p., 14th	16th	29.48	SW	SW., —	WNW	SW., 9	SW.-W.
West Ison, Am. S. S.	Tsingtau	Seattle	48 33 N.	176 46 E.	12th	10a., 12th	18th	29.18	SE	SE., —	SSW	SE., 9	
Boren, Swed. S. S.	Cadiz, P. I.	San Francisco.	42 24 N.	168 20 W.	15th	2p., 15th	16th	29.16	S	S., 8	W	WSW., 9	S.-SW.-W.
Reiyo Maru, Jap. S. S.	Otaru, Japan.	Vancouver	42 38 N.	160 18 E.	16th	10a., 17th	17th	28.83	WNW	NW., —	NW	NW., 9	WNW.-NW.
Kaikyu Maru, Jap. S. S.	Muroran	do	51 11 N.	153 54 W.	16th	5p., 17th	17th	29.04	SE	SSE., 9	S	SSE., 9	S.-E.-S.
Akibasan Maru, Jap. S. S.	Yokohama	San Francisco.	47 03 N.	157 27 W.	19th	8a	19th	28.43	S	S., —	SSW	S., 11	S.-SSW.
Dellwood, Am. S. S.	Seattle	Alaska	51 05 N.	130 05 W.	20th	8a., 21st	21st	29.92	SSE	SSE., 9	SW	—, 10	SSE.-SW.
Tahchee, Br. S. S.	Shanghai	San Francisco.	39 N.	179 W.	21st	2p., 21st	22d	28.94	S	WSW., 9	NW	NW., 10	WSW.-NW.
Eldridge, Am. S. S.	Yokohama	Seattle	49 56 N.	144 20 W.	23d	Noon	23d	29.87	E	E., 8	E	E., 8	Steady.
West Cadron, Am. S. S.	Otaru	Portland	46 51 N.	152 W.	26th	Noon	26th	28.80	SE	SE., 9	SW	SW., 10	SE.-S.-SW.
Tenpaisan Maru, Jap. S. S.	Miike	Tacoma	47 40 N.	176 30 W.	25th	4p., 26th	27th	29.26	NW	NW., 9	NW	W., 9	W.-WNW.
West Carmona, Am. S. S.	Hongkong	San Francisco.	41 12 N.	178 30 E.	24th	6p., 29th	29th	29.20	SE	WSW., 7	NW	SSW., 9	SE.-S.-SW.
West O'Rowa, Am. S. S.	Yokohama	Portland	43 36 N.	169 14 E.	27th	2p	27th	29.14	SE	SE., 9	SW	SE., 9	SW.-W.
Shabonee, Br. S. S.	Shanghai	San Francisco.	37 57 N.	150 05 E.	28th	4a	28th	29.53	NW	NW., 8	NW	NW., 8	
Somedono Maru, Jap. S. S.	Wakamatsu	Willapa	50 35 N.	175 20 W.	28th	5a	28th	28.94	SE	SE., 10	ESE	SE., 10	2 pts.
India Arrow, Am. S. S.	Shanghai	San Pedro	38 13 N.	156 09 W.	27th	Mdt., 27th	28th	29.69	NNW	NW., 8	NW	NW., 9	NNW.-NW.
Manulani, Am. S. S.	San Francisco.	Hawaiian Is.	27 N.	149 10 W.	27th	8a., 29th	29th	29.48	SW	NW., 11	N	NW., 11	NW.-NNE.
Niagara, Br. S. S.	Honolulu	Victoria	30 48 N.	149 28 W.	28th	6p., 28th	29th	29.46	N	N., 11	E	N., 11	
Carriso, Am. S. S.	Hilo	San Francisco.	28 44 N.	142 24 W.	28th	4p., 28th	29th	29.52	SE	SE., 10	SE	SE., 10	SE.-E.
Manoa, Am. S. S.	San Francisco.	Honolulu	29 10 N.	144 50 W.	28th	5a., 29th	29th	29.31	SE	W., 9	NW	W., 9	
Pres. Grant, Am. S. S.	Yokohama	Victoria	39 45 N	149 20 E.	28th	2a., 28th	29th	29.26	NW	NNW., 6	NW	NW., 10	Steady.

96500—26——3

OBSERVATIONS FROM GREENLAND

Weather observations broadcast from the recently installed radio station at Julianehaab, Greenland, are now being received regularly in Europe, and since March 19 have been published on the British Daily Weather Maps. It is expected that these observations will shortly be regularly available in the United States and Canada. The Canadian radio station at Belle Isle is under instructions to pick up these messages, and is already receiving them irregularly. Julianehaab will also later collect and transmit weather messages from the low-power radio stations at Godthaab and Godhavn, on the west coast, and Angmagssalik, on the east coast of Greenland.—*W. E. Hurd.*

NORTH PACIFIC OCEAN

By WILLIS EDWIN HURD

A glance at the pressures over the North Pacific Ocean for March, 1926, shows again, as in January, a considerable departure from the average. The center of the Aleutian LOW was at Dutch Harbor, with a pressure of 29.27 inches, almost a half inch below the normal. The crest of the anticyclone lay a few hundred miles southwest of the Washington coast. At Tatoosh Island the monthly pressure of 30.15, was 0.17 inch above the average. Hence the normal March gradient of 0.24 inch between Dutch Harbor and Tatoosh Island increased this month to 0.95 inch, thus establishing an extraordinary gradient for the time of year.

The following pressure table gives data for several land stations:

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level at indicated hours, North Pacific Ocean, March, 1926*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Dutch Harbor [1]	29.20	−0.47	30.07	12th	27.98	18th.
St. Paul [1]	29.45	−0.30	30.16	do	28.44	do.
Kodiak [1]	29.52	−0.23	30.22	30th	28.56	19th.
Midway Island [1]	30.06	−0.02	30.24	11th	29.80	1st.
Honolulu [2]	30.07	+0.03	30.23	7th	29.85	31st.
Juneau [2]	29.99	+0.05	30.52	23d	29.12	21st.
Tatoosh Island [2 3]	30.15	+0.17	30.45	22d	29.68	30th.
San Francisco [2 3]	30.03	−0.02	30.38	11th	29.68	24th.
San Diego [2 3]	30.00	−0.02	30.30	do	29.74	do.

[1] P. m. observations only.
[2] A. m. and p. m. observations.
[3] Corrected to 24-hour mean.

NOTE.—Correction indicates telegraphed pressure readings for February, 1926, at Dutch Harbor, were too low. Average should be 29.25 instead of 29.20.

In connection with the active cyclonic circulation which continued over the greater part of the northern half of the ocean, gales and heavy snow squalls were frequent. The American steamer *West Hixton*, en route from Oregon toward Japan, reported snow squalls daily west of longitude 160° W., from the 1st to the 13th of March, when she arrived at her destination. More snow seems to have fallen along the northern steamship routes over the western two-thirds of the ocean than during any of the three previous months. On the contrary, over the eastern part of the Gulf of Alaska, probably less snow fell than usual. At Juneau, while precipitation was much more than the average, the total snowfall, 0.1 inch, was the least ever known for the month. This March was the second warmest on record at Juneau, and was the warmest of record at various places along the American coast, including San Francisco and San Diego. The month was also warmer than the average at Honolulu.

Observations indicated few gales along the north American coastline. These include some moderate northeasters over and southwest of the Gulf of Tehuantepec, and the few gales reported by steamships off British Columbia. West of 140° W. gales were frequent to 170° E., but between there and the Japanese coast, from 30° to 50° N., they occurred on a greater number of days than elsewhere.

Two storms of considerable violence appeared upon the maps. On March 10 and 11 a cyclone emerged from Japan, accompanied by heavy snow and whole to hurricane gales east of Hokkaido, and lesser gales as far south as the Ogasawara Islands. As the storm moved eastward, near-hurricane winds accompanied it until the 13th. On that date gales of force 11 occurred over a considerable region south of Kamchatka. After the 13th the energy of the disturbance abated. Meanwhile, over the west-central Aleutians, there gathered one of the fluctuating centers of the Aleutian LOW. The progressive cyclone joined forces with it near the one hundred and eightieth meridian and 50° N., on the 17th, and from this merger there developed a vast low pressure area between Japan and British Columbia, at the center of which, Dutch Harbor, the pressure on the morning of the 18th had diminished to 27.98 inches. This was more than 2 inches lower than the pressure readings at that time at both Vancouver and the Hawaiian Islands. Singularly enough, despite the gradient, on that day there were no reports of gales exceeding force 9 on the ocean, but on the 19th near-hurricane winds were encountered in the neighborhood of 48° N., 155° W. The progressive movement of the storm continued, and the center entered the British northwest on the 21st.

The second important storm was in the process of development on the 26th as a secondary to the LOW then central over the Aleutians, but it was not until the following day, at which time it was central near 35° N., 150° W., that it acquired much energy. On the 28th and 29th it attained considerable violence in its northwestern quadrant, where gales of force 11 were experienced by steamers bound to or from the Hawaiian Islands. The storm took a rather extraordinary southward course, being central on the 29th at about 27° N., 152° W. On the 30th, in 25° N., it lost most of its energy, though it continued as a depression east to northeast of Hawaii until the end of the month.

The prevailing wind at Honolulu, as during many months past, was from the east, though the maximum wind velocity, 34 miles per hour, was from the southwest, during the formation of the cyclone to the northward on the 26th. March was the fifth consecutive month here with deficient precipitation, and the eighth with excess temperature.

Fog was observed less frequently than for several months past along our coast. There was little change in the frequency of its occurrence otherwise since February over the eastern part of the ocean. It was reported on the greatest number of days, principally during the last decade, near 50° N., 140° W. Reports of fog were infrequent from east longitudes, and it seems to have been confined largely to coastal waters east of Japan and between Hongkong and Shanghai.

An ice field about 5 miles in diameter was reported on the 10th, in 43° 04′ N., 146° 28′ E., and was also observed in the neighborhood on several other dates.

NOTES

By John Preller, second officer American steamer *Tejon*, San Pedro to Balboa.—"March 28, 3 p. m., local time. In latitude 16° 56′ N., longitude 100° 36′ W., noted a mirage. The steamship *Empress of Scotland* passed about 5′ to the southward, and at times she appeared as if cut in two, her center disappearing, while at other times bow and stern were lost and only the middle showing. Sea smooth at the time. Sky clear. Variable winds during the day boxing the compass."

By W. H. Walker, master of the American steamer *Eelbeck*, Panama to Honolulu.—"On the passage of the American steamship *Eelbeck* from Panama Canal to Honolulu, on the great circle track, there was a complete absence of the northeast trade winds; the vessel passing through light variable winds and calms for 16 days. On the 28th of March, however, when in longitude 143° West, the ship met with strong winds from the southward, accompanied by a rough sea and heavy rain. This lasted for 15 hours, shifting to the west and northwest, bringing up a high head sea which continued to retard the vessel's progress until reaching the vicinity of the islands, when the sea moderated. This unusual weather delayed the ship 24 hours."

—*W. E. H.*

DETAILS OF THE WEATHER IN THE UNITED STATES

GENERAL CONDITIONS

During the first half of the month the movement of cyclonic storms was mostly along the northern border but toward the end several rather intense storms developed in the far Southwest and moving across the central valleys passed off to sea. During the passage of one of these storms heavy snow fell over the southern Great Plains regions—Kansas to Texas. Another feature common to all of the months of 1926 was the great increase in energy of the cyclonic storms when reaching the Canadian Maritime Provinces and adjacent oceanic ares.

Temperature east of the Rocky Mountains, except over Montana and the Dakotas, was below normal several degrees as shown on Chart III; it was above normal by the same amount west of the Rockies. The usual details follow.—*A. J. H.*

CYCLONES AND ANTICYCLONES

By W. P. DAY

The first 12 days of the month were marked by generally high pressure over Canada and an accompanying succession of high-pressure areas from this region spreading southward over the United States. Five of the seven Alberta HIGHS were charted during this period. During the remainder of the month the HIGHS were more varied with respect to place of origin. The HIGH which appeared in the Northwest about the 25th was a combination of Alberta and North Pacific types.

Eighteen LOWS were plotted, several of which were quite important as storms. Of the latter, four were of the Texas type, i. e., secondaries developing over northeastern Mexico and southern Texas.

FREE-AIR SUMMARY

By V. E. JAKL

The free-air temperature departures at all aerological stations were negative (see Table 1) and as a rule increased somewhat with altitude. This departure aloft extended to some portions of the country where surface temperatures were above normal, as over North Dakota, where Chart III, this REVIEW, shows that it was warmer than normal. Over Ellendale a change to a negative departure took place at no great elevation above the ground, the average departure increasing with altitude to −3° C. at 4,000 meters. The greatest departure was at Royal Center, in the general vicinity of which the surface negative departure, as shown on Chart III, was also greatest. Relative humidities showed no important departure at any station.

Free-air winds were of more northerly component and greater velocity than normal, the general directions having been about northwest over middle sections of the country and more nearly west over eastern sections (see Table 2). Except at San Francisco, winds having a decided easterly component to high altitudes were almost absent, even over the most southerly stations. At San Francisco they were observed on 10 days scattered throughout the month. An exception is also noted at Ithaca, where a northeasterly wind was observed on the 21st to 10,000 meters.

Examples of wind velocity increasing rapidly with altitude as surface friction is surmounted are very common. However, instances of rapid increase are also occasionally observed that obviously can not be thus accounted for, as at Broken Arrow on the 2d. This observation showed a stratum of light northeasterly wind extending 800 meters above the ground, at the top of which the velocity fell to 1 meter per second. Immediately above this stratum, the wind changed abruptly to westerly and increased in velocity to 18 meters per second at 1,300 meters and to 32 meters per second in the next 3,000 meters. A somewhat similar condition is noted in the record of the afternoon two-theodolite pilot balloon observation at Groesbeck on the 26th, where a northeasterly wind extended with diminishing velocity to 2,000 meters, above which an abrupt change to southwesterly occurred, with rapid increase in velocity from 1 meter per second at 2,000 meters to 27 meters per second at 4,100 meters. In both cases a higher sea level pressure is found to the north or northeast of the station, which accounts for the northeasterly winds in the lower levels, and a general pressure and temperature situation over the country as a whole to account for the strong westerly winds in the upper levels, with evidently a sharp line of discontinuity intervening. Where an abrupt change in direction with altitude occurs, under ordinary conditions of fair weather, the velocities in the transition stratum are always very light.

An indication that surface friction over a not very rough terrain is ineffectual in causing turbulence to any perceptible height when the temperature is rising aloft is shown by the record at Drexel on the morning of the 17th, when a steady southerly surface wind of from 8 to 10 meters per second increased to 30 meters per second from the southwest 400 meters above the ground. The surface and aerological observations indicate that at the time of morning surface minimum temperature (−1.1° C.) the temperature increased steadily with altitude to 16.4° at 400 meters. As soon as insolation began the surface temperature rose rapidly to a maximum of 23.3° C. in 8 hours. If, before insolation began, turbulence had extended to any considerable height, a positive lapse rate would have been observed within that height.

The kite flights at Royal Center on the 16th and 17th show a change to higher free-air temperatures from one day to the next, the station on the first day being in front of a LOW and on the second under relatively higher pressure in the rear of a HIGH. A similar temperature change is noted in the Washington Naval Air Station airplane records of the 5th and 6th, where the change was

from a position in front of a HIGH to one of higher pressure just in the rear of its crest. These changes appear to be related to a condition which has been commented on before in connection with a rapid recovery of temperature which takes place above the northwestern stations in the colder season, after the crest of a cold HIGH has just passed and the air near the ground is still very cold.

The following record of the kite observation at Royal Center on the 31st is of interest because it was made in a snowstorm when the station was close to the center of the deep circular LOW that covered the eastern half of the country on that date. The temperature record shows conclusively that in this LOW there was no uninterrupted ascending current in the central region of the cyclone within the height limit of the observation.

Altitude m. s. l. (meters)	Temperature	$\frac{\Delta t}{100\ m.}$	Relative humidity	Wind direction	Wind velocity
	° C.		*Per cent*		*M. p. s.*
225 (surface)	−1.3		98	WSW	15
850	−6.0	.75	100	WSW	21
1951	−9.3	.30	98	W	27
2327	−6.3	−.80	100	W	22
2758	−7.3	.23	100	W	

Aerological kite work was discontinued at Drexel at the termination of March 31, and no further kite records from that station will therefore appear after this issue of the REVIEW.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during March, 1926*

TEMPERATURE (° C.)

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233 meters)		Drexel, Nebr. (396 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)	
	Mean	Departure from 8-yr. mean	Mean	Departure from 11-yr. mean	Mean	Departure from 6-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 8-yr. mean
Surface	8.1	−1.8	1.8	−1.2	8.9	−3.5	−2.7	0.0	10.6	−2.5	−0.8	−4.6
250	8.0	−1.8			8.6	−3.5			10.0	−2.5	−1.1	−4.7
500	6.6	−1.4	0.8	−1.6	6.6	−3.6	−3.1	−0.2	8.8	−2.5	−2.9	−4.5

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during March, 1926*—Continued

TEMPERATURE (° C.)

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233 meters)		Drexel, Nebr. (396 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)	
	Mean	Departure from 8-yr. mean	Mean	Departure from 11-yr. mean	Mean	Departure from 6-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 8-yr. mean	Mean	Departure from 8-yr. mean
750	5.4	−1.3	−0.8	−2.2	5.1	−3.6	−4.7	−1.1	8.2	−2.2	−4.3	−4.8
1,000	4.2	−1.7	−2.1	−3.0	4.2	−3.3	−5.7	−1.7	7.4	−2.3	−5.4	−5.1
1,250	3.1	−2.2	−3.5	−4.2	3.1	−3.2	−6.8	−2.2	6.8	−2.3	−5.9	−4.9
1,500	2.5	−2.1	−4.4	−4.7	2.1	−3.0	−7.7	−2.5	5.9	−2.5	−6.7	−4.9
2,000	0.5	−2.3	−5.3	−3.9	0.6	−2.3	−9.6	−2.7	4.4	−2.5	−8.2	−4.9
2,500	−1.7	−2.1	−7.7	−3.8	−1.9	−2.5	−11.5	−2.3	2.8	−2.0	−10.2	−4.7
3,000	−4.0	−1.8	−10.6	−4.1	−4.6	−3.0	−14.4	−2.5	0.0	−2.4	−12.7	−4.8
3,500	−7.0	−2.0	−13.3	−4.1	−7.6	−3.6	−17.4	−2.9			−16.1	−5.7
4,000	−10.1	−1.9	−15.9	−4.1	−10.0	−3.2	−20.2	−3.0			−19.0	−6.1
4,500	−12.3	−1.3	−19.0	−3.9			−22.1	−2.0			−22.0	−6.2
5,000			−22.2	−3.8			−24.0	−1.0				

RELATIVE HUMIDITY (%)

Altitude m. s. l. (meters)	Broken Arrow: Mean	Departure	Drexel: Mean	Departure	Due West: Mean	Departure	Ellendale: Mean	Departure	Groesbeck: Mean	Departure	Royal Center: Mean	Departure
Surface	60	−4	61	−7	59	−3	64	−9	70	+1	74	+3
250	60	−4			59	−3			68	0	74	+3
500	60	−3	61	−6	59	−2	64	−8	63	−2	75	+5
750	61	−1	61	−4	58	−3	63	−4	58	−4	77	+9
1,000	64	+4	60	−1	56	−5	62	−1	56	−2	75	+10
1,250	62	+6	59	+3	55	−6	62	+3	57	+3	70	+8
1,500	59	+7	55	+3	53	−7	62	+5	58	+8	66	+6
2,000	54	+9	47	−3	49	−6	58	+3	55	+13	64	+7
2,500	45	+4	48	−2	49	−1	53	−1	51	+13	63	+7
3,000	40	+1	49	−2	46	+1	52	−2	49	+14	61	+6
3,500	36	−2	51	0	47	+5	49	−5			56	+5
4,000	31	−6	45	−5	46	+3	47	−5			51	+2
4,500	23	−12	43	−9			43	−8			59	+4
5,000			45	−5			41	−10				

VAPOR PRESSURE (mb.)

Altitude m. s. l. (meters)	Broken Arrow: Mean	Departure	Drexel: Mean	Departure	Due West: Mean	Departure	Ellendale: Mean	Departure	Groesbeck: Mean	Departure	Royal Center: Mean	Departure
Surface	6.84	−1.38	4.36	−0.83	7.12	−2.35	3.28	−0.52	9.06	−2.12	4.51	−1.61
250	6.82	−1.33			7.01	−2.81			8.42	−2.24	4.45	−1.56
500	6.24	−1.02	4.11	−0.80	6.20	−2.13	3.19	−0.51	7.16	−2.38	3.89	−1.25
750	5.80	−0.74	3.77	−0.61	5.58	−1.97	2.82	−0.42	6.26	−2.36	3.59	−1.00
1,000	5.60	−0.41	3.38	−0.54	5.09	−1.85	2.58	−0.35	5.66	−2.03	3.28	−0.86
1,250	5.14	−0.29	3.05	−0.46	4.61	−1.74	2.39	−0.30	5.46	−1.30	2.88	−0.87
1,500	4.73	−0.11	2.66	−0.49	4.11	−1.55	2.24	−0.24	5.22	−0.70	2.53	−0.89
2,000	3.73	0.00	2.06	−0.58	3.40	−1.02	1.80	−0.31	4.45	+0.09	2.34	−0.58
2,500	2.77	−0.21	1.73	−0.51	2.80	−0.53	1.46	−0.20	3.60	+0.24	2.04	−0.47
3,000	2.08	−0.34	1.51	−0.38	2.18	−0.19	1.20	−0.21	3.02	+0.40	1.58	−0.54
3,500	1.32	−0.61	1.15	−0.40	1.80	+0.08	0.95	−0.19			0.79	−0.75
4,000	0.78	−0.74	0.67	−0.63	1.44	+0.08	0.88	−0.04			0.11	−1.09
4,500	0.36	−0.90	0.26	−0.85			0.82	+0.07				
5,000			0.01	−0.66			0.79	+0.16				

TABLE 2.—*Free air resultant winds (m. p. s.) during March, 1926*

Altitude m. s. l. (meters)	Broken Arrow, Okla. (233 meters)				Drexel, Nebr. (396 meters)				Due West, S. C. (217 meters)			
	Mean		8-year mean		Mean		11-year mean		Mean		6-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	N.58°W.	1.8	S. 16°W.	1.8	N.34°W.	2.3	S. 71°W.	0.6	S. 81°W.	3.1	S. 73°W.	2.1
250	N.63°W.	1.8	S. 14°W.	2.0					S. 81°W.	3.3	S. 72°W.	2.3
500	N.72°W.	2.7	S. 18°W.	3.2	N.40°W.	3.0	S. 69°W.	0.9	S. 82°W.	6.0	S. 77°W.	3.5
750	N.66°W.	3.6	S. 23°W.	4.0	N.50°W.	5.1	S. 85°W.	2.3	S. 85°W.	6.6	S. 78°W.	4.7
1,000	N.65°W.	4.1	S. 35°W.	4.8	N.50°W.	6.5	N.86°W.	3.3	S. 88°W.	7.6	S. 77°W.	5.9
1,250	N.67°W.	5.0	S. 49°W.	5.6	N.47°W.	7.7	N.79°W.	4.3	N.87°W.	8.7	S. 79°W.	7.1
1,500	N.59°W.	6.0	S. 67°W.	5.9	N.38°W.	8.6	N.77°W.	5.3	N.86°W.	10.5	S. 80°W.	8.9
2,000	N.56°W.	8.0	S. 81°W.	6.9	N.28°W.	9.2	N.76°W.	6.7	N.86°W.	13.3	S. 83°W.	11.2
2,500	N.61°W.	9.2	N.89°W.	8.4	N.39°W.	11.6	N.80°W.	8.8	N.89°W.	15.7	W.	12.7
3,000	N.68°W.	11.5	N.84°W.	9.9	N.43°W.	12.6	N.83°W.	11.3	S. 89°W.	19.0	S. 85°W.	14.4
3,500	N.74°W.	12.2	S. 86°W.	10.7	N.50°W.	15.2	N.79°W.	14.6	N.79°W.	21.2	S. 87°W.	14.5
4,000	S. 73°W.	12.7	S. 78°W.	10.4	N.58°W.	15.3	N.75°W.	17.7	N.68°W.	23.2	W.	16.3
4,500	S. 57°W.	15.8	S. 62°W.	12.3	N.45°W.	17.0	N.76°W.	17.3	N.68°W.	19.1	S. 88°W.	16.5
5,000	S. 67°W.	6.0	S. 58°W.	6.6	N.45°W.	19.0	N.67°W.	17.1				

Altitude m. s. l. (meters)	Ellendale, N. Dak. (444 meters)				Groesbeck, Tex. (141 meters)				Royal Center, Ind. (225 meters)			
	Mean		9-year mean		Mean		8-year mean		Mean		8-year mean	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	N.30°W.	3.2	N.41°W.	2.1	N. 13°E.	2.2	S. 14°E.	0.8	N.81°W.	1.9	S. 52°W.	1.6
250					N. 16°E.	2.5	S. 11°E.	1.5	W.	1.9	S. 47°W.	1.8
500	N.32°W.	3.4	N.45°W.	2.1	N. 43°E.	2.0	S. 4°W.	3.0	N.88°W.	3.0	S. 55°W.	4.2
750	N.33°W.	4.0	N.66°W.	2.5	N. 10°E.	2.2	S. 21°W.	3.7	N.84°W.	4.2	S. 61°W.	5.4
1,000	N.37°W.	4.4	N.73°W.	3.2	N.10°W.	2.9	S. 35°W.	4.2	N.78°W.	4.5	S. 68°W.	6.1
1,250	N.43°W.	5.0	N.71°W.	4.0	N.38°W.	3.3	S. 45°W.	4.7	N.83°W.	5.4	S. 75°W.	7.3
1,500	N.49°W.	6.2	N.73°W.	5.3	N.55°W.	3.8	S. 52°W.	5.0	N.72°W.	7.2	S. 83°W.	8.2
2,000	N.48°W.	8.0	N.73°W.	7.1	N.64°W.	6.1	S. 65°W.	6.4	N.70°W.	9.5	S. 86°W.	9.6
2,500	N.48°W.	9.6	N.73°W.	9.4	N.74°W.	8.6	S. 69°W.	8.6	N.74°W.	9.0	S. 88°W.	10.6
3,000	N.54°W.	13.8	N.74°W.	11.2	N.68°W.	9.6	S. 72°W.	9.5	N.71°W.	13.1	N.87°W.	13.5
3,500	N.65°W.	14.4	N.80°W.	12.8	N.22°W.	8.9	S. 75°W.	12.5	N.77°W.	14.7	N.89°W.	16.1
4,000	N.57°W.	9.8	N.83°W.	14.3					N.79°W.	15.4	S. 89°W.	15.2
4,500	N.52°W.	8.5	N.87°W.	14.2					N.67°W.	16.0	N.89°W.	14.0
5,000	N.58°W.	9.7	N.83°W.	15.0								

TABLE 3.—*Mean free-air temperatures, relative humidities and vapor pressures and resultant winds during March, 1926, at Washington, D. C.*

Altitude m. s. l. (meters)	Naval Air Station (7 meters)			Weather Bureau (34 meters)	
	Temperature	Relative humidity	Vapor pressure	Direction of wind	Velocity
	°C.	Per cent	Mb.		M. p. s.
Surface	1.6	68	5.08	N. 55° W.	2.1
250	0.6	66	4.68	N. 68° W.	4.3
500	−0.2	64	4.33	N. 65° W.	3.1
750	−1.3	63	3.98	N. 66° W.	7.4
1,000	−2.5	63	3.73	N. 64° W.	8.4
1.250	−3.8	64	3.44		
1,500	−4.9	63	3.11	N. 68° W.	10.7
2,000	−6.8	61	2.51	N 73° W.	11.6
2,500	−8.6	58	1.98	N. 70° W.	11.3
3,000	−11.0	55	1.56	N. 75° W.	13.0
4,500	−13.4	52	1.17	N. 59° W.	13.8
3,000	−16.6	51	0.89	N. 48° W.	15.0
4,500	−19.8	49	0.69	N. 52° W.	14.7

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

The atmospheric circulation was distinctly sluggish for the first month of spring from the Rocky Mountains westward, no cyclone of importance entering the United States from the Pacific coast during the entire month, nor were anticyclones particularly active, though the pressure was moderately high over the far Northwest during much of the month.

East of the Rockies there were about the normal number of cyclones moving from the British Northwest, but they entered the United States somewhat farther east than usual and were mainly effective over the northern districts from the Great Lakes eastward. In one case, however, a storm entered the United States from the Canadian Northwest and moved directly toward the South Atlantic States, but it covered only a narrow area and caused little precipitation until after reaching the coast where it recurved to the Northeast and developed considerable importance after passing to sea. Several cyclones developed over the far Southwest or in the vicinity of the west Gulf and moved either directly toward the Great Lakes or pursued a more easterly course over the Gulf States and thence northeastward near the Atlantic coast.

Over a large area embracing the middle and northern portions of the Plateau and Great Plains there was little important storm activity.

The principal precipitation of the month was associated, as is usually the case, with the southwestern storms, though one of northern origin passing eastward over Lake Michigan on the morning of the 7th brought some heavy precipitation during that and the following day to the Ohio and middle Mississippi Valleys and over the Atlantic Coast States from the Carolinas to southern New England.

A cyclone giving important precipitation in the Gulf States, developed over southeastern Texas on the 10th and moving slightly northeastward reached the south Atlantic coast by the morning of the 11th whence it passed northeastward into the ocean without important development. The precipitation attending this storm ranged up to two inches or more over large areas in the Gulf and South Atlantic States.

A most unusual case of heavy rain without important evidence of cyclonic action occurred in the vicinity of New Orleans on the 20th, when in connection with a local thunderstorm nearly 6.50 inches of precipitation occurred in a period of less than 12 hours. Other southwestern storms giving precipitation of importance over the southern and eastern districts passed over those sections on the 22–24 and 25–27.

The most important storm developed over the far Southwest on the morning of the 29th and by the following morning the center had advanced to Arkansas whence it moved to northern Indiana by the morning of the 31st as a storm of wide extent and severe character. It was attended by heavy snows in the southern Rocky Mountain region and over a wide area thence northeastward to the Great Lakes, while heavy rains prevailed over large areas from Texas eastward to the South Atlantic States and northeastward to the Ohio Valley.

Snowfall, heavier than had occurred at any time during the winter, was reported from numerous sections from the Texas panhandle northeastward, the amounts being phenomenally heavy in portions of western and northern Illinois and near-by portions of other States High winds drifted the snow to such an extent that transportation was greatly hampered and in some instances suspended entirely for several days.

The average pressure was well above normal from the Southern Plains north and northeast to, and including, the western Canadian Provinces, and in most other portions of the country save California and from the Great Lakes and Ohio Valley east to the Atlantic coast, including the Canadian Maritime Provinces.

Compared with February just preceding, the average pressures were mainly higher, and decidedly so over the central valleys, the far Northwest, and the western Canadian Provinces. They were slightly lower than in February, over the Southwest and in California and portions of near-by States. Usually the average March pressures are below those of February in practically all parts of both countries.

The month was notably free from high winds over the western half of the country, particularly over the Pacific coast section where at a number of points the total wind movement was the least of record for March. In the central and eastern districts the first two decades were without important storms, but the last decade had some high winds, particularly in the Southwest during the early part of the decade and from Texas northeastward to the Great Lakes from the 29th to 31st. The details of these storms will be found in the table at the end of this section.

TEMPERATURE

The persistent mild temperatures which had featured much of the winter over large portions of the country were not found in March except in the far West, and in the last week a marked change occurred over the Rocky Mountain and Plateau States so that unseasonable cold prevailed thereafter almost throughout the country save in the Pacific and Atlantic States.

The first half of March brought a number of quick changes from cool weather to warm, or vice versa, in districts east of the Rocky Mountains, but was generally colder than normal over this area save in the northern half of the Plains, where the period was largely warmer than normal. The temperature deficiency was notable in the Ohio Valley and Pennsylvania and thence southward almost to the Gulf Coast, where this half-month averaged generally from 8° to 14° cooler than normal, while an excess nearly as great was prevailing at the same time in Montana and districts adjacent. In the latter part of the second decade the warmth became even more

marked in the upper Missouri Valley, and temperatures rose to normal in the vicinity of the Mississippi River and more gradually to eastward, though much of New York and New England remained cooler than normal, as did most of the coast districts from North Carolina to Texas. A marked break in the long-continued warmth in the Northwest came about the 24th, and the cold wave quickly extended eastward and southward, so that, as already noted, the final week of March was cool over nearly all the country.

March, as a whole, was cooler than normal throughout the eastern half of the country and from Texas and New Mexico northward to the southern portions of Wyoming and Nebraska. South of the Ohio River and central Virginia this March was very nearly the coldest of record, and the abnormality is further brought out by the fact that the month actually averaged colder than February just before it in the lower Ohio Valley and almost everywhere to southeastward, where the normal rise in temperature from February to March is about 8° to 12°. The average deficiency of the March temperature was about 6° to 7° over most of the Ohio Valley and the southern Appalachian region, and about as great in Vermont and northern New York.

The region west of the Continental Divide, together with Montana, the Dakotas and parts of Minnesota, Iowa, Nebraska and Wyoming, averaged warmer than normal. The excess was greatest, 6° to 8° per day, in interior California and was about as great in the eastern half of Montana, though this latter area experienced a cold week at the close of the month.

From January 1 to March 23, Havre, Mont., averaged 15.7° warmer than normal. In Idaho, Washington, and Oregon, as well as Montana, the winter, as a whole, has been easily the mildest of record. March by itself was the warmest March of record, or almost the warmest, in all parts of the Pacific States, and in much of Nevada and Idaho; but in Montana it failed by almost 8° to equal the mark of March, 1910.

The highest temperatures occurred usually very near the middle of the month in the far Northwest and on the northern coast of California, on the 22d or 23d in the rest of California, and nearly always between the 18th and the 25th in all other sections, save in Florida where most of them occurred on the last day.

The lowest marks were reached about the 5th or 6th or else about the 14th in the Lake region and Ohio Valley and districts to the east, nearly always on the 13th, 14th, or 15th from eastern Kansas and the central valleys southward and southeastward, chiefly on the 7th or near the end of the month in the Dakotas and Nebraska, mostly about the 6th or on the 29th in the far Northwest and in the middle Plateau area, but usually about the 10th in California and Arizona. Several places in the southeastern portion of the country report the low readings on the 14th as the lowest of record so late in March.

PRECIPITATION

The distribution of precipitation was decidedly uneven, an excess being found in almost all southern portions from eastern Arizona to the south Atlantic coast, in most of the upper Lake region, and in a few other scattered districts. An area extending from southeastern Texas to southern Alabama received amounts from 9 to 17 inches, the heaviest falls occurring in southeastern Louisiana. Texas and Louisiana report that no March since their State-wide services were organized has averaged as wet as this one.

There was decidedly little precipitation in most portions of the Pacific States, particularly in central and northern California and the southern half of Oregon, many stations reporting this as the driest March of record. Likewise the Missouri Valley had very little, notably the upper half; and there were considerable deficiencies in several smaller areas, as northeastern Iowa and southern Wisconsin, the Middle Atlantic States and southern New England, and the southern third of the Florida peninsula.

The districts in eastern Texas and near the middle Gulf coast which had such large totals for the month received most of the rain during the latter half and other districts between Arizona and northern Florida received the bulk of their precipitation during the final week. In the northeastern portion the falls were well distributed through the month, but the north Pacific region received its supply chiefly during the middle decade.

SNOWFALL

Again the snowfall was much less than the normal in western mountain districts, being surprisingly scanty in the Pacific States, Montana, Idaho, and Nevada, and much of Utah and Wyoming.

Southeast of these districts, however, the March snowfall was more abundant, especially in New Mexico, where it averaged almost as much as the maximum received in March.

The northern plains had but little, but the middle Plains, most of Oklahoma and the Texas Panhandle had large falls, the chief one as the month neared its close. Owing to the snowfall of this same storm as it moved on eastward, most of Missouri, Iowa, Illinois, and northern Indiana had large monthly amounts, and traffic was much delayed as a result. In the Lake region and eastward the month's snowfall was not far from normal, but near the middle Atlantic coast there was usually very little. In most of North Carolina and parts of the States adjoining, on the other hand, considerable amounts of snow for March fell early in the second decade.

In the elevated portions of the far West the stored snow at the end of March was very generally less than the average quantity at that date, the deficiency being particularly marked in all parts of the Pacific States and most of Arizona. The prospects for summer water flow are poor in nearly every portion of those States. Somewhat less unsatisfactory were the snow conditions in Nevada, Idaho, Montana, and Utah. On the other hand, from Wyoming to New Mexico the snow supply is not far from the average, and many river systems flowing eastward from the Continental Divide are expected to carry somewhat more than their normal quantities of water.

RELATIVE HUMIDITY

Generally the relative humidity was less than normal over the greater part of the country, the principal exceptions being the central and southern Rocky Mountain region, where it was in excess, frequently by a large per cent, and there were slight excesses in the Southern Plains and over much of the Lake region.

The deficiency was generally large in the middle and East Gulf States, over the southern drainage of the Ohio, in the Appalachian Mountain region, and from the Missouri Valley westward including most of California and the middle Plateau.

SEVERE LOCAL HAIL AND WIND STORMS, MARCH, 1926

The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau.

Place	Date	Time	Width of path	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
			Yards					
Milwaukee, Wis	1	P. m.				Wind and snow	Branches of trees broken; 10 accidents occurred	Journal (Milwaukee, Wis.).
Due West, S. C	2					High wind	Doors blown off of reel house at station, auto tops damaged and telephone lines out of service.	Official, U. S. Weather Bureau.
Tucson, Ariz	5	1 p. m.				Heavy hail	Storm covered 15 blocks; no damage reported	Do.
Iowa	5					Snow and wind	Greatest damage in northern part; drifts retarded rail traffic and caused suspension of motor transportation.	Do.
New Orleans, La	10	3-3.30 p. m				Wind	Telephone, electric light and street car service impaired; trees and fences blown down.	Do.
Weleetka, Okla	19	7.30 p. m.	3,570		$50,000	Heavy hail	Considerable property and crop damage over path four miles long.	Do.
Navarro County, Tex	21	2-2.30 a. m	3-7 mi.			Severe wind and hail.	Several buildings wrecked, others unroofed. Damage in Powell about $11,000.	Do.
Palestine, Tex	21	7.17 a. m.-5 p. m.				Thunderstorm	Roads and bridges washed out, causing delay to railway traffic.	Do.
Franklin, Tenn	22	P. m.			7,000	do	Church damaged	Do.
East of Continental Divide, Mont.	23	P. m.			6,000	High wind	Buildings damaged or destroyed at Fort Benton, Billings, and Circle; considerable injury to winter wheat.	Do.
Vincent, Tex	24	11.30 p. m.	200		2,000	Small tornado	Some damage to property	Do.
Orange County, Tex	25	8 a. m.	880	1	200,000	Violent wind	Greatest damage in oil fields where 138 derricks were demolished. Eight persons injured.	Do.
Jacksonville, Fla., and vicinity.	26					High wind and heavy rain.	Timber, telegraph and telephone lines prostrated.	Do.
Salome, Ariz	26	8.15 p. m.				Heavy hail	Small birds killed by stones; considerable damage to property and injury to fruit and vegetables.	Do.
Tekamah, Nebr. (3 miles NW. of).	27	1.30 p. m.			100	Whirlwind	Framework of small barn wrecked; carpenter injured.	Do.
Sacaton, Ariz	28	3.15-3.45 p. m.	3-4 miles			Heavy hail	Severe damage reported	Do.
Constellation, Ariz	29	4.30 a. m.	3,520			do	Storm passed over mining and grazing districts; no damage reported.	Do.
Santa Rita Range Reserve, Continental, Ariz.	29	12-12.10 p.				Hail	Slight damage to grasses and weeds	Do.
Eastern and south-central counties, Kansas.	29-31					Snowstorm	Train service greatly hampered, traffic on some lines completely stopped for a day or two.	Do.
Liberty (3 miles east of) Liberty County, Texas.	30	3 a. m.	266-633	2	200,000	Tornado	Many oil derricks and weak buildings destroyed; three persons injured.	Do.
Sealy (near) to Wallis (near), Austin County, Texas.	30	3-3.30 a. m.	440	2	30,000	do	Considerable damage to buildings; two persons injured.	Do.
Harris and Jefferson Counties, Texas.	30	3-4 a. m.		1	1,770,000	Series of violent thunderstorms accompanied by hail and wind.	Coastal oil interest greatest losers; many homes and business houses damaged or demolished; a number of persons injured.	Do.
Lake Charles, La	30	6 a. m.				Wind, rain, electrical, and hail.	Truck and early gardens beaten by hail	Journal (Shreveport, La.).
Norwood, La	30	7 a. m.				Wind	Almost every home damaged; upper story blown from factory and roof from cotton gin.	Do.
Meridian, Miss., and vicinity.	30	9 a. m.			30,000	Hail and wind	Windows broken, chimneys blown over, trees uprooted and a few frame buildings wrecked.	Official, U. S. Weather Bureau.
Alexandria, La., and vicinity	30	A. m.				Wind and hail	Trees and signs damaged; church at Woodworth demolished.	Journal (Shreveport, La.).
Independence, La	30	do				do	Several buildings unroofed; many autos damaged.	Do.
Kinder, La. (3 miles north of).	30	do				Tornadic wind	Farm home and school building demolished. Oak trees uprooted and pines twisted off over path 5 miles long. Three persons injured.	Do.
Southwest Georgia	30	10-12 p. m.			20,000	Tornadic wind	A few small country residences and barns demolished; trees blown down; several persons injured.	Official, U. S. Weather Bureau.
Nashville, Tenn	30	P. m.				Wind	Tin work torn from buildings; a number of light globes broken.	Do.
Beauregard and Evangeline Parishes, La.	30					Wind and hail	Timber damaged, truck gardens injured	Do.
Dilley, Tex. (vicinity of)	30					do	Crops destroyed, necessitating replanting	Do.
Mobile, Ala	30	2.30 p. m.	166		5,000	Tornadic wind	Two frame buildings demolished; chimneys and outhouses blown down, trees uprooted; some wire damage. Path about 2,200 feet.	Do.
Pensacola, Fla	30				650	Wind	Lighter loaded with lumber sunk	Do.
Central and northern Illinois	30-31					Snow and wind	Transportation greatly or entirely suspended in northern portion; many accidents reported.	Do.
Iowa	30-31					do	Greatest damage along Mississippi River, particularly at Dubuque; much inconvenience to every phase of life.	Do.
Alpena, Mich., and vicinity	31					Wind and snow	Telegraph and telephone lines damaged; highways impassable, trains delayed.	Do.
Cambridge, Ohio (near)	31					Wind and rain	A number of buildings damaged	News (Dayton, Ohio).
Evansville, Ind., and vicinity.	31					Wind	Insecure fences, signs, and chimneys blown down; wires damaged by falling trees; river navigation interrupted.	Official, U. S. Weather Bureau.
Ludington, Mich	31					Wind and snow	Highways obstructed; navigation partially suspended.	Do.
Parkersburg, W. Va	31					Wind	Overhead wires damaged	Do.

STORMS AND WEATHER WARNINGS

WASHINGTON FORECAST DISTRICT

On the morning of the 1st, southwest storm warnings were ordered from Delaware Breakwater to Eastport. On the 2d northwest storm warnings were ordered from Delaware Breakwater to Hatteras. From Delaware Breakwater to Eastport, warnings were changed to northwest on the 2d and continued on the 3d. Strong winds and gales occurred. Small-craft warnings were displayed on the 6th from Miami to Charleston and on the Alabama and extreme northwest Florida coasts, and fresh winds occurred. Southwest warnings were ordered on the morning of the 7th from Cape Hatteras to Portland and were extended northward to Eastport on the evening of that date. On the following morning the warnings were changed to northwest. Strong winds and gales occurred as indicated. On the morning of the 9th small-craft warnings were ordered from Eastport to Hatteras and fresh to strong winds occurred.

On the morning of the 10th small-craft warnings were ordered from Mobile to Apalachicola and fresh to strong winds occurred during the afternoon. On the 11th small-craft warnings were displayed from Atlantic City to Jacksonville.

Small-craft warnings were issued on the 23d from Hatteras to Boston and fresh winds occurred.

On the morning of the 25th storm warnings were displayed from Hatteras to Portland, in connection with a disturbance over northern New York, and on the following morning warnings were ordered from Jacksonville to Boston in connection with a disturbance of considerable intensity over North Carolina. Strong winds occurred generally, but were not severe.

With centers of disturbances over the Rio Grande Valley on the evening of the 29th, storm warnings were displayed between Bay St. Louis, Miss., and Tampa, Fla.

On the afternoon of the 30th storm warnings were ordered from Titusville, Fla., to Atlantic City, N. J., and on the evening of that date were extended northward to Boston. Strong winds and gales occurred generally over the region of display.

Warnings of frosts or freezing temperatures were issued for portions of the South Atlantic and East Gulf States on the 2d, 3d, 7th, 8th, 9th, 12th, 13th, 15th, 16th, 23d, 25th, 26th, 27th, 30th, and 31st. The frosts and freezing temperatures that occurred on the 14th were the most important of the month, minimum temperatures from 2° to 4° below freezing being reported as far south as the East Gulf coast and northern Florida, considerable damage to fruit blossoms resulting.—*R. H. Weightman.*

CHICAGO FORECAST DISTRICT

The weather was unusually cold for the season in the Great Lakes region and the Mississippi and Ohio and lower Missouri valleys. The storms passed across the southern and eastern portions of the district in rapid succession, bringing large falls of snow to the Great Lakes region and portions of the Southwest. Record-breaking snowfall for the month of March was registered at several stations. The precipitation was seldom in the form of rain, except in the extreme southern portion of the forecast district. On the other hand, the temperature was mild and precipitation deficient in the northern plains.

The month opened with a disturbance passing across the Great Lakes, accompanied by snow and strong winds. Later a disturbance gradually developed in the west, and passed eastward across middle districts with steadily increasing intensity. On the 6th and 7th, precipitation was widespread, and the accompanying winds were rather strong, with falling temperature following in the wake of the disturbance. Advisory messages were sent to open ports on Lake Michigan in the interests of navigation, and cold-wave warnings were issued for a considerable portion of the district.

Another storm immediately developed in the southwest, and passing eastward it skirted the southern portion of the Chicago forecast district on the 10th and 11th, accompanied by extensive rain and snow.

Disturbances of lesser importance passed across the district in rapid succession during the following two weeks, causing a continuation of the unsettled conditions in much of the forecast district, chiefly from the Great Lakes southward and southwestward to the limits of the region.

One of the most important storms was a combination, apparently, of two disturbances—one from the northwest and another from the southwest—which joined together in a well-marked LOW over the upper Mississippi Valley on the morning of March 24. The center passed directly eastward across the Great Lakes, with some snow and strong northwest winds, followed by a marked fall in temperature. The usual advisory warnings were issued to open ports of Lake Michigan.

The weather continued unsettled and stormy, and on the morning of the 28th a well-marked storm appeared to be developing in the far Southwest, and this passed first east-southeastward across the west Gulf States and then turned northeastward by the morning of the 30th from the lower Missouri Valley across the Ohio Valley and Great Lakes Region. The storm was most unusual for the season, because of its record-breaking snowfall over a wide area. The accompanying winds, moreover, drifted the snow badly and transportation was much affected. Warnings of severe weather conditions were broadcast. The pressure at the center of this storm as it passed over the southern Lake Region fell to 29 inches or lower.—*H. J. Cox.*

NEW ORLEANS FORECAST DISTRICT

Storm warnings were issued for parts of the Texas coast on March 25, 29, and 30, and small-craft warnings for parts of the west Gulf coast on the 7th, 24th, 25th, and 30th; subsequent conditions justified these warnings.

Cold-wave warnings were issued for Oklahoma on the 5th, and a cold wave occurred. Frost or freezing temperatures occurred in parts of the district on several dates, for which timely warnings were issued. Livestock warnings for snows or hard freeze were issued for the northern portion of the district on the 26th, 28th, 29th, and 30th, and there was heavy snow with hard freeze. No severe weather occurred without warning.—*I. M. Cline.*

DENVER FORECAST DISTRICT

Low pressures prevailed over the southern and extreme western portions of the district during most of the month, with frequent LOWS also moving eastward along the northwestern border. The succeeding northwestern HIGHS, however, were without their usual intensity. As results of these pressure conditions, temperatures were generally much above normal in the extreme northern and western portions of the district, with a marked deficiency in precipitation. In southeastern Wyoming, eastern Colorado and New Mexico there was an excess of precipitation, attended by temperatures generally below the seasonal average.

Aside from a local cold wave at Flagstaff, Ariz., on the 11th, the only cold wave of the month occurred in eastern New Mexico on the 29th and 30th, when a LOW which was central over northeastern Arizona on the morning of the 29th divided, one center advancing rapidly to extreme southern Texas, the other remaining over southwestern Colorado. Cold wave warnings were not issued, but warnings of colder in New Mexico, with frost or freezing temperature, were distributed on the morning of the 29th.

Warnings of frost or freezing temperature which were generally verified were issued for portions of the whole of New Mexico, on the 6th, 7th, 8th, 10th, 11th, 12th, 15th, 21st, 24th, 25th, 26th, 27th, 28th, 29th, 30th, and 31st; for south-central and southeastern Arizona on the 11th, 21st and 29th, and for the valleys of western Colorado on the 21st, 22nd, 24th, 25th, 26th, 27th, 28th, 29th, 30th, and 31st.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT

The month of March gave exceptionally high temperatures over all parts of the forecast district. At many stations in California the month was the warmest March of record and at some stations in the State it was both the warmest and driest March of record. Only one frost warning was required for California, but warnings of frosts and of freezing temperatures were issued on a number of days for Nevada, Idaho, Washington and Oregon, because high temperatures during March and the previous months forced vegetation to advance far beyond what it normally does at this season. The few storm warnings were restricted to the coast north of Cape Blanco; i. e., the Washington and Oregon coasts.

Among the outstanding facts noted in regard to the past winter are these: (1) No cold-wave warning was issued or necessary for any part of this forecast district and (2) the periods of general rains in California have followed in all instances the disintegration of the area of high pressure that normally is central some distance off the California coast. A notable instance of this occurred during the latter part of January. The barometer had stood high off our coast and the weather consequently remained dry during the time. Rains were general and heavy in the State while the barometer stood low over the region where it is normally high and ceased quickly after the pressure rose above normal. A similar instance occurred after the end of March. This will be referred to in the report for the month of April.—*E. H. Bowie*

RIVERS AND FLOODS

By H. C. FRANKENFIELD

The great ice gorge that had prevailed since January 8 in the Allegheny River of Pennsylvania gave way and passed down the river during the early evening of March 23. A special report on this gorge appears on page 106 in this REVIEW.

Moderate floods occurred during March in the rivers of the Southern States, except the lower Mississippi, the Illinois, and Wabash Rivers and their tributaries, the Grand and Saginaw systems of Michigan, and portions of the Maumee system of Ohio. There were also moderate local floods in the Sabine, Trinity, and Little Rivers of Texas. All of the floods were realtively unimportant, although only absence of heavy rains prevented a decided flood in the rivers of southern lower Michigan and northern Ohio. As it was, the melting of snow and ice due to the high temperatures of the last decade of the month caused only moderate flood stages, and the losses were very small, although many business interests suffered considerable inconvenience for a short time.

Warnings of the floods were ample, and the aggregate losses were very small. The totals reported for the large territory east of the Mississippi River were only $32,900, while those from the Texas floods were $54,000, with a reported saving through the warnings of $52,500.

The ice in the Missouri River in the vicinity of Bismarck broke up on March 21 and 22 and passed down the river with little damage. Ample warning of the event was issued. The crest stage at Bismarck was 14.6 feet, 0.4 foot below the flood stage.

In New England and eastern New York there was still on the ground an unusual amount of snow with a large water equivalent, excellent potential flood conditions which a few weeks later were resolved into actual ones of which mention will be made hereafter.

Owing to the comparative mildness of the last three consecutive winters the Connecticut River below East Hartford bridge has been continuously kept open for navigation, although on a few occasions the use of tugs was resorted to in order to maintain an open channel.

Flood stages during month of March, 1926

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE	Feet			Feet	
Susquehanna: Oneonta, N. Y.	12	26	26	12.2	26
Neuse: Smithfield, N. C.	14	15	15	14.0	15
Peedee: Mars Bluff, S. C.	17	1	2	17.7	1 and 2
		16	16	17.0	16
Santee:					
Rimini, S. C.	12	[1]	21	14.7	2 and 4
Ferguson, S. C.	12	[1]	22	13.5	3
Oconee: Milledgeville, Ga.	22	31	[2]	22.3	31
Ocmulgee:					
Macon, Ga.	18	31	[2]	20.0	31
Abbeville, Ga.	11	4	6	11.3	5
Altamaha: Everett City, Ga.	10	3	8	10.1	4, 5, 6
		11	15	10.0	11 to 15
EAST GULF DRAINAGE					
Chattahoochee: Columbus, Ga.	20	31	[2]	29.0	31
Tombigbee: Lock No. 4, Demopolis, Ala.	39	11	18	43.9	15
Pearl:					
Jackson, Miss.	20	10	23	27.0	16, 17, 18
Columbia, Miss.	18	23	26	19.0	25
West Pearl: Pearl River, La.	13	14	[2]	15.7	27
GREAT LAKES DRAINAGE					
Maumee: Napoleon, Ohio	10	[1]	[3]	13.6	Feb. 27
St. Joseph: Montpelier, Ohio	10	[1]	1	12.4	Feb. 27
		24	24	10.0	Mar. 24
Saginaw: Saginaw, Mich.	19	25	28	20.1	26
Shiawassee: Chesaning, Mich.	17	23	23	17.3	23
Flint: Flint, Mich.	11	23	27	13.9	25
Pine: Alma, Mich.	7	22	26	7.5	23
Cass: Vassar, Mich.	14	22	26	15.6	24
Grand:					
Eaton Rapids, Mich.	5	[1]	3	5.3	1
		20	31	5.7	26
Lansing, Mich.	11	21	24	11.4	22
Grand Ledge, Mich.	7	[1]	3	8.4	2
		7	7	7.0	7
		19	28	9.0	21-22
Lowell, Mich.	15	24	24	15.0	24
Grand Rapids, Mich.	11	22	29	13.3	25
Red Cedar:					
Williamston, Mich.	6	2	2	6.0	2
		20	25	8.5	26
East Lansing, Mich.	8	20	26	9.7	20
MISSISSIPPI DRAINAGE					
Allegheny: Franklin, Pa.	15	[1]	5	[4] 24.0	Feb. 26
		8	8	[4] 15.2	Mar. 8
		21	23	20.6	22
Shenango: Sharon, Pa.	9	25	25	9.2	25
Tuscarawas:					
Gnadenhutten, Ohio	9	[1]	1	13.5	Feb. 27
		24	25	9.7	Mar. 24
Coshocton, Ohio	8	[1]	[3]	10.6	Feb. 27

[1] Continued from last month.
[2] Continued at end of month.
[3] Below flood stage, 8 a. m., Mar. 1.
[4] Ice gorge.

Flood stages during month of March, 1926—Continued

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI DRAINAGE—continued					
Wabash:	*Feet*			*Feet*	
Lafayette, Ind	11	(1)	1	16.2	27
Mount Carmel, Ill	16	1	4	16.9	Mar. 3-4
Tippecanoe: Norway, Ind	6	3	3	6.2	3
		22	23	6.1	22-23
White, West Fork: Edwardsport, Ind	15	(1)	3	18.3	Feb. 28
		24	26	15.6	Mar. 25
Rock: Lyndon, Ill	10	(1)	2	13.9	Feb. 27
Illinois:					
Peru, Ill	14	(1)	12	17.8	27
Henry, Ill	10	(1)	8	10.8	Mar. 3
Havana, Ill	14	3	13	14.3	4-7
Beardstown, Ill	14	3	15	14.7	7
Black:					
Corning, Ark	11	(1)	9	12.2	2-3
		12	22	12.1	15-17
Black Rock, Ark	14	12	16	15.2	13
Sulphur, Ringo Crossing, Tex	20	24	25	20.4	24
WEST GULF DRAINAGE					
Sabine: Logansport, La	25	24	31	28.9	27
Trinity:					
Dallas, Tex	25	23	23	25.4	23
Trinidad, Tex	28	27	29	28.9	28
Little: Little River, Tex	30	11	11	34.7	11
PACIFIC DRAINAGE					
Gila: Kelvin, Ariz	5	30	30	5.0	30

[1] Continued from last month.

MEAN LAKE LEVELS DURING MARCH, 1926

By UNITED STATES LAKE SURVEY

[Detroit, Mich., April 15, 1926]

The following data are reported in the Notice to Mariners of the above date:

Data	Lakes [1]			
	Superior	Michigan and Huron	Erie	Ontario
Mean level during March, 1926:	*Feet*	*Feet*	*Feet*	*Feet*
Above mean sea level at New York	600.19	577.52	570.02	244.14
Above or below—				
Mean stage of February, 1926	−0.08	+0.10	+0.12	+0.04
Mean stage of March, 1925	−0.55	−0.78	−0.91	−1.06
Average stage for March, last 10 years	−0.39	−2.19	−1.55	−1.26
Highest recorded March stage	−2.13	−5.43	−3.83	−3.67
Lowest recorded March stage	−0.47	−0.78	−0.81	−0.16
Average departure (since 1860) of the March level from the February level	−0.10	+0.15	+0.19	+0.26

[1] Lake St. Clair's level: In March, 1926, 572.28 feet.

THE EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, MARCH, 1926

By J. B. KINCER

General summary.—The prevailing cool weather east of the Mississippi River, and frequent precipitation in the interior and Southern States, made conditions generally unfavorable for farming operations during March over the eastern part of the country. In the South, the soil continued too wet during much of the month for the preparation of land and the seeding of spring crops, and it was too cool for proper germination of seed. There was also considerable frost damage to fruit and early vegetables in the Southeastern States about the middle of the month and, near the close, some additional harm was reported in scattered localities in South-Central States and in the southern Rocky Mountain area.

In the central and northern portions of the trans-Mississippi States, where rainfall was light to moderate and temperatures seasonable, conditions were much better and seasonal farm operations made satisfactory advance. Precipitation was deficient in the northern Plains, however, and more moisture was needed over a considerable area of the Northwest. In the more western States, the generally mild weather and absence of storms were favorable for livestock, and there was sufficient rain in the far Southwest to materially improve range conditions. In the Pacific Coast States, vegetation advanced rapidly under the influence of the generally mild weather, and the season was well advanced.

The planting of cotton made slow progress, and very little had been put in at the close of the month, though considerable preparation of seed beds was accomplished. In the western belt a little cotton was planted the latter part of the month as far north as southern Arkansas, and in the east some was seeded locally northward to southern South Carolina.

Pastures and miscellaneous crops.—Over the great western grazing country the weather was generally favorable for the range, except that more moisture was needed in a few localities, particularly in parts of the Pacific Northwest. The mild temperatures were unusually favorable for lambing in the northern portions of the range country, and good results were reported. In the South pastures made fairly good progress.

There was considerable injury by frost to early fruit and vegetables in the Southeast about the middle of the month, and some were damaged in many localities over a belt extending from New Mexico, Oklahoma, and southern Kansas eastward near the close. Harm from low temperatures was more or less localized, however, and no extensive areas were affected. Minor spring crops needed warmth and sunshine throughout the Southern States.

Small grains.—The month was mostly favorable for winter wheat, though growth was slow because of cool weather, particularly in the central and eastern portions of the belt, where the late-seeded grain showed little progress; the early-seeded continued in satisfactory condition. In the western portion of the belt the crop was favorably affected by the prevailing weather and good advance was reported. Heavy precipitation over the south-central Great Plains near the close of the month was especially favorable for this crop. The seeding of spring wheat made normal advance under favorable weather conditions, but in some sections of the belt more moisture was needed for germination. Oat seeding made fairly good progress in the Central-Western States, but from the Mississippi Valley eastward this work was much delayed by the prevailing cool, wet weather. Grain crops made good advance in the far West.

Corn and cotton.—Plowing for corn was materially delayed from the Mississippi Valley eastward, and was at a standstill during much of the month because of persistently wet soil. It was also rather unfavorable for planting in the Southern States and too cool for good germination. In the Atlantic coast area conditions became somewhat more favorable the latter part of the month, and at its close some corn had been planted as far north as North Carolina. In the West some was seeded northward to the extreme southern Great Plains.

CLIMATOLOGICAL TABLES [1]

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, March, 1926

Station	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.	°F.	In.	In.		In.		In.
Alabama	50.0	−6.1	Brewton	85	21	Valley Head	13	14	6.52	+0.87	Citronelle	12.36	Scottsboro	2.88
Arizona	54.7	+1.4	Yuma Citrus Station	94	2	Bright Angel	−14	6	2.02	+1.04	Young	5.18	Mohawk	0.00
Arkansas	48.5	−4.2	Dardanelle	86	24	Gravette	11	8	5.57	+0.83	Springbank	9.23	Searcy	2.04
California	57.2	+5.6	2 stations	96	[2] 15	Helm Creek	0	[2] 2	0.37	−3.43	Springville	2.41	9 stations	0.00
Colorado	33.5	−0.9	Lamar	82	17	Hermit	−20	7	1.75	+0.46	La Veta Pass	8.76	Grover	0.18
Florida	61.4	−4.4	Hypoluxo	92	31	Mount Pleasant	22	14	4.21	+1.38	Cottage Hill	13.00	Homestead	0.05
Georgia	49.9	−6.8	2 stations	83	[2] 23	Clayton	8	14	5.72	+0.93	Blakely	9.88	Saint George	2.95
Idaho	39.4	+3.9	Chattin's Flat	80	15	Stanley	−11	[2] 2	0.53	−0.96	Orofino	2.14	Ashton	0.02
Illinois	34.8	−5.8	Mascoutah	84	24	Alexander	1	13	2.51	−0.70	Mascoutah	3.64	Marengo	0.88
Indiana	34.3	−6.4	3 stations	78	[2] 23	Goshen	−9	17	3.05	−0.81	Marengo	5.16	Collegeville	0.81
Iowa	32.1	−2.6	Little Sioux	78	23	3 stations	−4	13	1.06	−0.69	Wescott	2.62	Harlan	0.20
Kansas	41.4	−2.5	Cawker City	84	23	Dresden	2	28	1.63	+0.13	Garden City	3.58	Hill City	0.14
Kentucky	40.3	−6.3	Franklin	84	18	2 stations	4	14	2.81	−2.03	Bowling Green (No. 2).	4.95	Pikeville	1.80
Louisiana	55.9	−5.1	Natchitoches	84	24	4 stations	25	[2] 14	11.41	+6.90	Saint Francisville	18.17	Tallulah	5.79
Maryland-Delaware	38.1	−4.5	7 stations	80	25	Oakland, Md	−8	6	2.22	−1.44	Grantsville, Md	4.51	Keedysville, Md	1.11
Michigan	23.9	−5.0	Berrien Springs	73	24	Ewen	−38	5	2.50	+0.42	Ironwood	7.33	Webber Dam	0.37
Minnesota	23.5	−2.2	Canby	70	[2] 21	2 stations	−33	13	0.96	−0.22	Meadowlands	2.22	Crookston	0.05
Mississippi	51.7	−5.5	Columbia	83	21	Okolona	12	14	7.60	+1.91	Woodville	15.13	Moorhead	2.55
Missouri	39.6	−4.2	2 stations	82	24	3 stations	8	13	2.89	−0.11	Caruthersville	5.53	Albany	0.74
Montana	35.0	+4.8	Crow Agency	75	9	Red Lodge	−9	29	0.38	−0.56	Adel	2.29	Cut Bank	0.00
Nebraska	36.4	+0.8	Alma	86	22	Haysprings	−6	7	0.64	−0.46	Orleans	2.29	Butte	0.02
Nevada	45.5	+4.0	Las Vegas	89	24	San Jacinto	−3	29	0.25	−0.56	2 stations	0.95	3 stations	0.00
New England	26.6	−4.0	2 stations	66	25	Pittsburg, N. H	−31	6	2.68	−0.96	Kingston, R. I	4.60	Van Buren, Me	1.13
New Jersey	35.2	−3.4	Tuckerton	79	25	Layton	0	6	2.25	−1.67	South Orange	3.15	Cape May	1.52
New Mexico	41.7	−1.6	Jal	81	[2] 18	Aragon	−10	30	2.09	+1.23	Aspen Grove Ranch	5.33	San Fidel	0.25
New York	27.0	−5.0	Ohioville	68	25	North Lake	−26	14	2.24	−0.82	North Lake	5.62	Lauterbrunnen	0.43
North Carolina	43.7	−5.9	Greenville	87	31	Parker	−7	14	4.29	−0.10	Newbern	6.45	Reidsville	2.87
North Dakota	25.8	+3.2	Ashley	83	22	Hansboro	−23	7	0.24	−0.59	Powers Lake	1.27	2 stations	0.00
Ohio	33.2	−6.4	3 stations	76	24	Bellefontaine	−7	17	2.28	−1.24	Wilmington	4.68	Youngstown	0.77
Oklahoma	47.3	−4.6	2 stations	86	24	3 stations	6	31	2.55	+0.53	Antlers	6.40	Oakwood	1.04
Oregon	48.7	+5.1	Marshfield	88	13	Lake	4	6	0.73	−2.11	Classic Lake	4.89	4 stations	0.00
Pennsylvania	33.1	−4.4	Hyndman	79	19	Saegerstown	−16	5	1.91	−1.63	Johnstown	3.94	Lawrenceville	0.58
South Carolina	48.8	−6.0	Blackville	83	25	Caesar's Head	6	14	4.49	+0.59	Edgefield	6.80	Summerville	2.34
South Dakota	32.1	+1.2	3 stations	79	[2] 20	Aberdeen	−12	7	0.28	−0.80	Harvey's Ranch	2.45	Academy	0.00
Tennessee	43.3	−6.5	6 stations	79	[2] 18	Newport	0	14	3.92	−1.46	Covington	7.10	Kingsport	2.71
Texas	55.1	−3.6	Falfurrias	94	2	Dalhart	9	31	4.81	+2.75	Bonwier	12.20	Fort Stockton	0.77
Utah	40.8	+2.9	Saint George	84	15	Woodruff	−6	29	0.77	−0.71	Woodland	2.65	2 stations	T.
Virginia	41.1	−5.0	Cape Henry	85	31	Burkes Garden	3	14	2.54	−1.16	Langley Field	4.45	Winchester	1.18
Washington	46.9	+5.6	Concrete	81	15	2 stations	12	[2] 4	1.06	−1.85	Cedar Lake	5.56	2 stations	T.
West Virginia	36.0	−6.8	6 stations	75	[2] 19	Bayard	−9	6	2.87	−0.94	Pickens	9.82	Upper Tract	0.35
Wisconsin	22.8	−6.2	Prairie du Chien	66	23	Long Lake	−37	13	1.64	−0.13	Plum Island	3.20	Grand River Locks	0.52
Wyoming	30.6	+0.5	Basin	75	23	Riverside	−20	29	0.63	−0.42	Dome Lake	2.71	Worland	T.
Alaska (February)	16.8	+1.2	3 stations	50	[2] 9	Allakaket	−55	[2] 25	4.50	+0.60	Ketchikan	19.94	Rampart	T.
Hawaii	70.0	+1.4	4 stations	88	[2] 9	Kula Sanitarium	38	31	1.96	−7.45	Olokele (Mauka)	13.50	Puu Kea	0.00
Porto Rico	75.3	+1.5	Canovanas	96	26	Albonito	46	16	2.09	−1.34	Carite Dam	4.51	Santa Rita	0.00

[1] For description of tables and charts, see REVIEW, January, 1926, page 32.
[2] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, March, 1926*

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England							29.6	−3.1										81	2.71	−1.1										4.8		
Eastport	76	67	85	29.74	29.83	−.10	26.2	−2.7	48	22	33	6	5	20	23	25	21	70	2.94	−1.3	11	8,102	nw.	44	nw.	29	8	9	14	6.1	10.3	T.
Greenville, Me.	1,070	6		28.65	29.86		19.3		55	22	30	−16	14	8	41				2.31		9	6,291	nw.	43		29	15	4	12		20.8	
Portland, Me.	103	82	117	29.78	29.90	−.06	28.4	−3.4	49	22	36	5	5	21	25	25	18	65	3.54	−0.2	12	6,792	nw.	38	nw.	29	16	3	12	4.6	7.6	1.0
Concord	289	70	79	29.57	29.90	−.10	27.4	−3.4	56	22	37	4	15	18	37				1.85	−1.6	8	4,502	nw.	27	nw.	29	18	7	6	3.5	7.3	T.
Burlington	403	11	48	29.47	29.93	−.07	22.4	−6.7	47	22	30	−9	14	14	36				1.93	+0.1	10	6,862	s.	48	se.	31	6	9	16	6.5	14.6	2.0
Northfield	876	12	60	28.94	29.92	−.08	19.7	−6.7	53	22	32	−18	6	8	46	18	14	80	1.54	−1.2	10	4,989	s.	33	s.	31	8	11	12	6.2	15.0	8.5
Boston	125	115	188	29.76	29.90	−.07	34.2	−1.4	60	22	42	12	5	27	26	29	22	62	2.91	−1.2	8	8,215	w.	29	sw.	8	14	8	9	4.7	2.8	0.0
Nantucket	12	14	90	29.88	29.89	−.09	33.5	−2.0	50	25	39	13	5	28	22	31	27	78	2.23	−1.8	11	12,524	w.	48	se.	31	11	13	7	5.4	0.8	0.0
Block Island	26	11	46	29.87	29.90	−.08	33.4	−2.0	50	25	39	14	5	28	19	30	25	72	2.55	−1.8	10	15,105	nw.	50	e.	31	14	11	6	4.0	0.6	0.0
Providence	160	215	251	29.73	29.91	−.07	33.2	−2.5	58	25	41	11	6	26	27	29	21	62	3.14	−1.5	10	10,621	nw.	46	nw.	24	13	11	7	4.4	2.4	0.0
Hartford	159	122	140	29.75	29.93	−.06	33.2	−1.8	62	25	41	10	6	25	30				3.28	−1.0	10		nw.				16	6	9	3.9	4.6	0.0
New Haven	106	74	153	29.82	29.94	−.05	34.1	−1.7	64	25	42	12	6	27	29	30	25	72	3.92	−0.5	10	7,595	nw.	30	nw.	9	17	9	5	3.4	0.9	0.0
Middle Atlantic States							37.1	−3.4										65	2.22	−1.5										5.0		
Albany	97	102	115	29.83	29.94	−.07	29.4	−3.3	54	25	37	4	6	22	25	26	21	72	1.61	−1.1	11	5,487	nw.	29	s.	23	11	8	12	5.2	1.7	T.
Binghamton	871	10	84	28.98	29.94	−.08	28.0	−4.6	55	25	36	−3	6	20	39				1.54	−1.1	13	5,032	nw.	24	se.	21	7	10	14	6.3	3.2	T.
New York	314	414	454	29.60	29.95	−.05	35.1	−2.6	66	25	43	13	5	28	26	29	21	60	2.52	−1.6	8	14,999	nw.	55	nw.	24	11	12	8	4.9	1.2	0.0
Harrisburg	374	94	104	29.57	29.99	−.04	35.8	−3.1	68	25	44	11	5	28	30	30	22	61	1.91	−1.2	8	6,671	nw.	32	sw.	25	11	6	14	5.6	0.8	0.0
Philadelphia	114	123	190	29.85	29.98	−.04	39.0	−1.8	71	25	47	16	5	31	25	33	25	61	1.96	−1.5	8	8,864	nw.	36	e.	31	13	12	6	4.7	0.1	0.0
Reading	325	81	98	29.60	29.97		36.6		70	25	45	14	5	28	30	32	27	71	1.80	−1.7	7	4,945	nw.	43	e.	31	15	9	7	4.5	1.0	0.0
Scranton	805	111	119	29.07	29.96	−.06	31.4	−4.3	62	25	40	4	6	23	32	26	20	68	1.93	−1.2	12	6,024	nw.	36	ne.	31	4	11	16	6.9	4.1	0.0
Atlantic City	52	37	172	29.91	29.97	−.05	36.8	−1.8	68	25	44	16	6	30	26	33	27	70	2.53	−1.2	8	14,507	w.	68	e.	31	14	12	5	3.8	T.	0.0
Cape May	17	13	49				38.8	−2.0	71	25	46	14	6	31	35				1.52		7										T.	
Sandy Hook	22	10	55	29.92	29.94		35.4		67	25	42	16	5	29	26	30	24	66	1.96		7	13,886	nw.	48	ne.	31	14	10	7	4.4	T.	0.0
Trenton	190	159	183	29.74	29.96		36.0		67	25	45	13	6	27	28	31	24	65	2.22	−1.8	8	10,023	nw.	40	e.	31	14	9	8	4.5	0.7	0.0
Baltimore	123	100	113	29.84	29.98	−.05	39.8	−2.5	76	25	48	18	5	32	29	34	26	61	2.19	−1.7	10	5,303	sw.	25	w.	23	11	11	9	5.3	T.	0.0
Washington	112	62	85	29.86	29.99	−.05	40.1	−2.5	76	25	49	17	5	31	30	33	24	58	2.07	−1.8	8	6,289	nw.	34	nw.	23	7	14	10	5.3	T.	0.0
Cape Henry	18	8	54	29.96	29.98		43.4		85	31	52	25	15	35	39	38	32	68	2.81	−1.5	12	11,946	w.	49	nw.	14	10	14	7	4.9	5.1	0.0
Lynchburg	681	153	188	29.24	30.00	−.05	42.5	−4.8	77	25	53	15	6	32	40	34	26	58	2.52	−1.3	13	7,074	nw.	39	w.	31	14	10	7	4.4	4.7	0.0
Norfolk	91	170	205	29.90	30.01	−.02	44.2	−4.0	82	31	54	22	14	35	33	37	30	63	3.11	−1.2	12	12,215	w.	60	w.	7	12	9	10	4.9	6.9	0.0
Richmond	144	11	52	29.85	30.01	−.03	43.0	−4.2	81	25	54	17	6	32	34	37	31	68	1.96	−1.8	10	7,852	sw.	52	sw.	31	17	8	6	3.9	5.0	0.0
Wytheville	2,304	49	55	27.57	30.01	−.04	35.9	−6.4	67	24	45	12	14	27	30	31	25	67	2.86	−1.6	17	6,949	w.	42	sw.	7	8	8	15	6.2	9.0	0.0
South Atlantic States							48.5	−5.2										69	4.34	+0.2										4.8		
Asheville	2,253	70	84	27.64	30.06	.00	39.6	−5.3	71	25	49	10	14	30	32	32	26	65	3.04	−0.9	10	8,540	nw.	35	nw.	13	14	6	11	4.8	10.5	0.0
Charlotte	779	55	62	29.18	30.03	−.02	45.0	−5.4	77	25	55	16	14	35	32	39	34	69	4.80	+0.2	11	5,308	sw.	36	sw.	31	12	11	8	4.7	6.7	0.0
Hatteras	11	11	50	29.99	30.00	−.04	47.2	−4.8	70	31	54	28	14	40	25	43	38	75	4.81	−0.7	8	13,678	sw.	60	n.	11	17	4	10	4.5	T.	0.0
Raleigh	376	103	110	29.61	30.03	−.02	45.2	−5.0	79	25	56	16	14	34	34	39	34	69	5.17	+0.9	13	7,670	sw.	44	sw.	31	11	10	10	5.0	6.4	0.0
Wilmington	78	81	91	29.96	30.05	.00	49.1	−4.2	76	25	59	21	14	39	29	43	37	69	4.19	+0.6	10	6,809	w.	36	w.	2	13	11	7	4.1	0.6	0.0
Charleston	48	11	92	30.01	30.06	.00	52.4	−5.0	77	23	61	25	14	44	26	46	40	67	3.61	−0.1	12	9,253	sw.	50	sw.	31	11	10	10	5.0	T.	0.0
Columbia, S. C.	351	41	57	29.67	30.06	.00	48.4	−6.8	78	24	58	20	14	38	33	41	34	64	5.00	+1.3	13	6,755	sw.	40	sw.	31	12	12	7	4.6	T.	0.0
Due West	711	10	55	29.28	30.07		45.4		76	24	56	18	14	35	33				4.54		10	8,482	w.	53	w.	2	14	8	9	4.6	T.	0.0
Greenville, S. C.	1,039	113	122	28.91	30.03		45.0	−4.9	76	24	54	18	14	35	30	38	31	64	5.17		9	8,744	sw.	54	sw.	31	16	7	8	4.0	4.2	0.0
Augusta	182	62	77	29.86	30.06	.00	50.0	−6.0	80	24	60	23	14	40	34	45	40	74	5.79	+0.9	10	5,596	nw.	36	w.	2	11	9	11	5.3	T.	0.0
Savannah	65	150	194	30.00	30.07	+.01	53.8	−5.2	77	25	63	27	14	45	26	47	42	72	4.74	+1.1	11	10,782	w.	54	nw.	13	10	8	13	5.3	0.0	0.0
Jacksonville	43	200	245	30.03	30.08	+.02	58.0	−4.6	78	31	66	28	14	50	26	51	46	71	2.20	−1.3	9	10,284	nw.	75	sw.	26	10	4	17	5.8	0.0	0.0
Florida Peninsula							67.5	−2.9										72	2.06	−0.2										5.0		
Key West	22	10	64	30.04	30.06	+.01	71.4	−1.2	86	31	77	56	15	66	16	64	61	76	0.42	−1.1	4	8,050	n.	25	nw.	11	14	11	6	4.2	0.0	0.0
Miami	25	71	79	30.06	30.09		68.4	−3.6	84	31	75	45	15	61	26	61	57	71	0.28	−2.3	3	5,419	se.	20	nw.	12	9	13	9	5.5	0.0	0.0
Tampa	35	79	87	30.04	30.08	+.01	62.8	−4.0	83	22	71	36	14	55	28	55	50	70	5.47	+2.7	8	5,073	w.	31	nw.	29	11	11	9	5.5	0.0	0.0
Titusville	44	5		30.03	30.08		62.3		86	25	72	33	14	52	35				4.70		9		w.				9	14	8	4.9	0.0	0.0
East Gulf States							51.7	−5.9										67	6.75	+0.9										6.1		
Atlanta	1,173	190	216	28.81	30.07	+.01	45.5	−6.5	75	24	54	18	14	37	24	39	31	63	4.97	−0.8	13	9,697	nw.	48	nw.	13	14	3	14	5.3	T.	0.0
Macon	370	78	87	29.68	30.08	+.02	49.3	−7.4	79	24	58	21	14	40	35	43	37	67	5.80	+0.3	9	5,756	nw.	31	nw.	13	10	8	13	5.4	T.	0.0
Thomasville	273	49	58	29.78	30.08	+.02	55.0	−5.2	79	21	64	26	14	46	26	47	40	66	5.55	+0.5	14	4,212	nw.	31	sw.	30	8	5	18	6.5	0.0	0.0
Apalachicola	36	42	49	30.05	30.09		56.8		75	23	64	31	14	50	22	51	47	76	6.01		11	7,294	n.	38	nw.	25	9	8	14	6.0	0.0	0.0
Pensacola	56	149	185	30.03	30.09	+.03	55.4	−4.9	76	23	62	29	14	49	19	50	46	75	6.89	+1.5	12	10,927	n.	64	s.	30	7	10	14	6.5	0.0	0.0
Anniston	741	9	57	29.30	30.10	+.04	46.7	−5.8	77	21	57	17	14	37	35				5.46	−0.3	12	5,921	nw.	30	w.	7	14	6	11	5.1	T.	0.0
Birmingham	700	11	48	29.32	30.10	+.04	48.2	−7.2	78	21	58	19	14	39	27	41	33	61	4.88	−0.9	9	6,316	nw.	32	w.	7	12	5	14	5.7	T.	0.0
Mobile	57	125	161	30.02	30.08	+.02	55.2	−4.5	79	23	63	29	14	48	23	48	42	68	9.42	+2.2	11	8,114	nw.	40	n.	30	5	9	17	6.7	0.0	0.0
Montgomery	223	100	112	29.85	30.10	+.04	51.6	−6.2	79	21	60	24	14	44	26	44	37	62	5.65	−0.7	12	6,139	nw.	28	n.	13	8	9	14	6.2	0.0	0.0
Corinth	469	6					47.8		76	24	58	19	14	37	31				4.20		11		n.				4	19	8		T.	0.0
Meridian	375	85	93	29.68	30.09	+.04	51.0	−6.1	76	24	60	22	14	42	32	44	37	64	4.61	−1.0	12	5,059	nw.	48	sw.	30	8	10	13	6.2	0.0	0.0
Vicksburg	247	65	73	29.82	30.11	+.07	53.1	−5.4	78	24	61	26	14	45	29	45	37	61	5.05	−1.2	11	5,754	se.	37	w.	31	9	6	16	6.3	0.0	0.0
New Orleans	53	76	84	30.03	30.08	+.04	57.6	−5.2	77	24	64	34	14	51	26	52	48	76	15.95	+10.6	14	5,505	e.	26	e.	29	7	9	15	6.8	0.0	0.0
West Gulf States							55.2	−3.9										74	5.69	+2.6										6.5		
Shreveport	249	77	93	29.82	30.10	+.08	54.0	−4.3	81	24	62	33	14	46	29	47	41	70	6.17	+1.6	10	5,563	se.	33	w.	31	11	5	15	6.0	T.	0.0
Bentonville	1,303	11	44				43.6	−3.7	76	24	53	22	13	35	32				3.34		10	5,057	nw.	20	w.	7	15	5	11		5.4	T.
Forth Smith	457	79	94	29.58	30.07	+.06	47.6	−5.0	82	24	56	28	13	39	38	41	35	67	2.80	−0.8	10	7,499	e.	35	sw.	30	11	7	13	5.9	0.2	0.0
Little Rock	357	136	144	29.69	30.08	+.05	48.7	−4.3	80	24	57	27	14	40	34	42	34	61	5.11	+0.2	10	7,780	e.	38	nw.	7	10	8	13	5.4	T.	0.0
Brownsville	57	53	61	29.93	29.99		67.0	−1.2	84	10	73	48	26	61	23	62	60	84	1.96		9	5,644	s.	28	n.	25	4	10	17	7.4	0.0	0.0
Corpus Christi	20	11	73	30.02	30.04	+.06	63.4	−1.6	81	10	69	46	31	58	20	59	56	82	3.18	+1.3	14	9,500	e.	38	ne.	15	6	5	20	7.5	0.0	0.0
Dallas	512	109	117	29.53	30.08		53.4		85	24	62	31	14	45	32				3.29		14	6,042	se.	33	nw.	30	10	6	15	6.1	0.9	0.0
Fort Worth	670	106	114	29.34	30.07	+.09	52.9	−4.8	85	24	61	30	14	44	32	46	40	68	3.60	+1.4	14	7,116	se.	37	ne.	30	8	8	15	6.5	T.	0.0
Galveston	54	106	114	30.01	30.07	+.06	58.9	−3.5	75	22	64	38	31	54	20	55	52	81	9.39	+6.5	14	9,125	se.	44	nw.	30	7	9	15	6.4	0.0	0.0
Groesbeck	461	11	56	29.58	30.06		54.1		78	24	62	32	14	46	35				6.64		17	7,532	n.	42	ne.	25	7	5	19	6.7	0.0	0.0
Houston	138	292	314	29.91	30.06		58.1	−5.4	79	22	65	36	31	51	22				9.18		15	10,386	e.	82	nw.	30	8	9	14	6.6	0.0	0.0
Palestine	510	64	72	29.54	30.08	+.08	53.9	−5.2	80	24	62	32	14	46	29	48	43	72	9.38	+5.9	15	5,875	n.	32	nw.	30	7	9	15	6.4	T.	0.0
Port Arthur	34	58	66	30.02	30.06		58.1		79	22	65	38	31	52	24	53	50	80	7.62		14	6,992	e.	38	nw.	30	7	8	16	6.3	0.0	0.0
San Antonio	693	119	132	29.31	30.04	+.06	58.6	−4.2	84	21	67	36	31	51	28	51	46	70	4.77	+3.1	17	6,397	ne.	48	nw.	30	6	10	15	6.5	0.0	0.0
Taylor	583	55	63	29.48	30.09	+.10	55.7	−4.0	79	21	64	32	31	48	33				6.82	+4.2	17	5,800	n.	30	nw.	30	6	8	17	7.1	0.0	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, March, 1926*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Thermometer above ground	Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Days with 0.01, or more	Wind: Total movement	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0–10	In.	In.
Ohio Valley and Tennessee							**38.2**	**−6.0**										**70**	**3.15**	**−1.3**										**6.6**		
Chattanooga	762	189	213	29.25	30.08	+.02	44.6	−6.6	77	24	54	18	14	35	28	37	28	57	5.38	−0.8	14	8,041	sw.	38	w.	2	9	11	11	5.6	9.5	0.0
Knoxville	995	102	111	28.98	30.06	.00	43.0	−5.7	76	24	52	17	14	34	30	36	28	60	2.82	−2.8	14	6,057	sw.	44	sw.	31	12	5	14	5.7	0.1	0.0
Memphis	399	76	97	29.65	30.08	+.04	47.4	−4.9	77	24	56	23	14	39	25	41	34	65	5.79	0.0	10	7,500	sw.	50	w.	31	11	10	10	5.0	T.	0.0
Nashville	546	168	191	29.50	30.10	+.05	43.2	−6.0	78	24	53	18	14	34	31	37	31	66	3.88	−1.6	11	8,714	nw.	56	se.	30	11	8	12	5.5	1.0	0.0
Lexington	989	193	230	28.96	30.06	+.01	36.7	−7.0	72	24	45	11	13	28	28				2.52	−2.2	18	11,967	sw.	56	sw.	31	7	9	15	6.4	4.6	0.1
Louisville	525	188	234	29.48	30.08	+.03	39.0	−6.4	76	24	48	16	3	30	27	34	29	71	2.66	−1.7	12	9,327	w.	50	sw.	31	6	9	16	6.5	1.8	T.
Evansville	431	139	175	29.60	30.09	+.05	40.3	−5.6	76	24	49	19	3	32	32	35	29	68	2.69	−1.9	12	10,182	nw.	48	sw.	31	4	14	13	6.8	1.0	T.
Indianapolis	822	194	230	29.13	30.04	.00	34.4	−5.6	74	24	43	10	8	26	30	30	26	76	3.12	−0.9	16	10,662	w.	44	w.	1	6	5	20	7.1	3.6	0.1
Royal Center	736	11	55	29.20	30.03		30.6		72	24	39	8	8	22	36				2.83		16	10,040	w.	40	w.	1	0	9	22	8.2	7.6	2.0
Terre Haute	575	96	129	29.41	30.05		36.2		75	24	44	11	8	28	29	32	28	77	2.76		10	9,003	nw.	36	sw.	31	4	9	18	7.2	1.9	T.
Cincinnati	627	11	51	29.34	30.04	−.01	35.4	−5.5	73	24	44	11	13	26	33		28	76	2.56	−1.1	13	7,538	sw.	41	sw.	31	7	4	20	6.9	6.1	T.
Columbus	822	179	222	29.12	30.02	−.02	33.4	−5.7	69	24	42	10	5	25	29	30	26	76	2.16	−1.0	15	8,681	w.	38	nw.	23	4	8	19	7.1	6.5	T.
Dayton	899	137	173	29.04	30.02		33.9	−6.6	71	24	42	11	8	25	30	30	25	73	2.71	−0.7	18	9,043	w.	49	sw.	31	5	10	16	6.8	4.3	T.
Elkins	1,947	50	67	27.91	30.04	−.01	32.4	−7.6	66	22	42	5	6	23	43	29	25	79	3.58	−0.5	23	5,823	w.	38	se.	31	5	8	18	7.5	18.2	0.0
Parkersburg	637	77	82	29.37	30.04	−.01	37.4	−5.4	70	19	46	12	5	28	35	32	26	68	2.49	−1.3	16	5,805	sw.	31	w.	31	6	9	16	7.1	5.2	0.0
Pittsburgh	842	353	410	29.07	30.00	−.04	33.8	−5.8	67	19	42	8	5	25	30	30	24	71	1.73	−1.3	15	10,351	w.	52	se.	31	8	7	16	6.4	3.3	0.0
Lower Lake Region							**28.2**	**−4.9**										**76**	**2.26**	**−0.4**										**6.5**		
Buffalo	767	247	280	29.10	29.96	−.06	26.8	−4.3	57	22	33	4	5	20	30	24	20	78	2.14	−0.5	19	13,557	sw.	64	sw.	31	6	12	13	6.5	11.2	0.0
Canton	448	10	61	29.42	29.92		20.2	−7.5	47	22	29	−10	5	12	32				3.76	+0.9	16	6,670	w.	31	se.	31	14	8	9	4.7	25.5	5.0
Oswego	335	76	91		29.95	−.06	26.4	−4.8	49	22	32	3	6	21	25			81	1.71	−1.1	16	8,664	nw.	36	sw.	31	5	4	22		20.3	0.1
Rochester	523	86	102	29.37	29.96	−.06	28.1	−3.7	57	22	34	7	6	22	30	24	19	70	2.08	−0.8	14	7,342	w.	33	w.	3	5	12	14	6.8	8.5	0.0
Syracuse	597	97	113	29.28	29.94	−.08	27.7	−3.7	53	22	34	1	5	22	28				1.72	−0.7	19	8,774	w.	36	se.	31	7	8	16	6.8	8.8	T.
Erie	714	130	166	29.18	29.98	−.04	29.6	−3.9	61	19	37	4	5	22	36	26	22	76	2.04	−0.6	17	10,683	w.	65	se.	31	6	13	12	6.2	7.1	0.0
Cleveland	762	190	201	29.15	29.99	−.04	30.8	−3.8	66	19	38	9	5	24	33	27	22	73	1.95	−0.8	14	11,521	w.	46	se.	31	2	8	21	7.5	4.3	T.
Sandusky	629	62	70	29.30	30.00	−.03	30.4	−4.7	65	19	38	10	5	23	33				2.18	−0.4	18	7,678	sw.	36	nw.	25	3	12	16	7.1	4.9	0.4
Toledo	628	208	243	29.30	30.00	−.03	30.6	−4.7	64	19	38	8	5	23	33	27	22	73	2.26	0.0	15	11,647	sw.	55	sw.	31	7	10	14	6.2	2.7	T.
Fort Wayne	856	113	124	29.05	30.00		30.4	−8.5	70	24	38	6	5	22	31	27	24	80	3.00		15	8,386	w.	40	sw.	31	2	13	16	7.1	7.3	0.7
Detroit	730	218	258	29.18	29.99	−.04	29.0	−4.4	59	19	36	8	5	22	30	25	21	76	2.71	+0.3	17	8,118	nw.	49	sw.	31	6	12	13	6.3	5.5	T.
Upper Lake Region							**23.4**	**−5.0**										**82**	**2.53**	**+0.3**										**6.6**		
Alpena	609	13	92	29.31	30.01	−.02	19.6	−5.9	44	21	28	−13	5	11	32	18	15	82	3.53	+1.5	13	9,143	nw.	54	e.	31	9	6	16	6.1	33.8	10.9
Escanaba	612	54	60	29.35	30.05	+.01	19.0	−5.2	45	23	28	−12	5	10	35	17	14	85	2.56	+0.6	12	8,034	n.	44	n.	2	8	11	12	5.7	26.1	4.5
Grand Haven	632	54	89	29.30	30.01	−.02	26.2	−5.5	54	24	33	2	5	19	33	24	21	82	2.33	−0.2	14	8,691	n.	43	w.	1	2	14	15	7.3	12.1	3.3
Grand Rapids	707	70	87	29.22	30.02	−.01	27.7	−5.7	59	19	35	3	5	20	30	25	21	78	1.90	−0.5	13	4,982	nw.	24	e.	31	4	8	19	7.5	12.9	1.5
Houghton	668	62	99	29.30	30.06	+.02	18.1	−4.7	56	21	26	−21	5	10	43				3.09	+1.0	12	7,824	w.	38	n.	2	9	7	15	6.3	27.4	8.8
Lansing	878	11	62	29.01	29.98		26.3	−5.9	57	19	35	1	5	18	36	24	23	90	3.13	+0.9	17	5,403	nw.	24	nw.	3	6	12	13	6.1	12.2	1.9
Ludington	637	60	66	29.29	30.01		24.8		45	24	31	3	5	19	22	23	20	81	2.53		15	7,742	n.	31	nw.	2	4	11	16	7.2	16.9	9.5
Marquette	734	77	111	29.22	30.05	+.01	20.7	−4.1	51	22	27	−3	5	14	23	19	16	84	3.11	+1.0	17	7,777	nw.	52	sw.	17	3	10	18	7.5	30.6	14.8
Port Huron	638	70	120	29.26	29.98	−.05	26.0	−4.4	47	19	32	5	5	20	28	24	22	84	3.04	+0.6	14	9,118	nw.	39	se.	31	6	12	13	6.1	14.0	T.
Saginaw	641			29.27	29.99		25.7	−5.8	51	19	34	1	5	17	32				2.43		17		nw.				6	8	17		8.9	1.7
Sault Sainte Marie	614	11	52	29.31	30.04	+.01	17.6	−4.0	43	21	26	−19	5	9	36	16	12	81	1.77	−0.1	10	6,515	nw.	28	nw.	27	11	8	12	5.8	17.4	4.2
Chicago	673	7	131	29.30	30.05	+.02	30.2	−5.1	71	24	37	9	8	24	30	27	22	76	3.14	+0.6	15	10,390	nw.	44	sw.	24	6	10	15	7.1	22.4	8.5
Green Bay	617	109	141	29.34	30.03	−.01	23.2	−5.4	55	23	31	−4	13	15	29	21	18	85	1.28	−1.1	11	8,771	nw.	43	n.	31	8	8	15	6.3	9.8	5.0
Milwaukee	681	125	139	29.26	30.02	−.01	27.7	−4.4	62	24	35	6	13	21	29	24	20	74	2.09	−0.6	14	8,331	nw.	42	ne.	31	7	7	17	7.1	24.4	11.3
Duluth	1,133	5	47	28.81	30.09	+.03	19.4	−4.3	54	23	28	−7	2	11	29	16	13	82	1.86	+0.3	10	10,229	nw.	51	nw.	1	9	13	9	5.7	18.1	T.
North Dakota							**25.6**	**+3.6**										**72**	**0.34**	**−0.6**										**5.2**		
Moorhead	940	50	58	29.06	30.12	+.04	23.4	+0.7	68	21	33	−8	7	14	42	20	16	77	0.77	−0.4	10	7,705	n.	35	n.	24	4	14	13	6.8	8.0	0.0
Bismarck	1,674	8	57	28.32	30.17	+.11	28.4	+4.2	73	23	40	−8	7	17	39	23	16	63	T.	−1.0	0	8,181	n.	39	n.	24	17	9	5	3.6	T.	0.0
Devils Lake	1,478	11	44	28.49	30.13	+.08	21.7	+3.2	63	20	32	−16	7	11	33	18	15	80	0.45	−0.6	6	8,569	n.	46	n.	24	10	12	9	5.2	3.6	T.
Ellendale	1,457	10	56	28.51	30.13		26.5		70	23	38	−8	7	15	42				0.20		7	11,885	nw.	58	n.	24	9	9	13	5.7	1.7	0.0
Grand Forks	835	12	89				22.6		66	21	32	−10	7	13	43	20			0.45		10		nw.	60	nw.	24	12	10	9	5.4	3.0	0.0
Williston	1,878	41	48	28.08	30.13	+.09	29.0	+6.1	66	23	40	−4	7	18	42	24	18	68	0.12	−0.6	3	6,742	nw.	40	w.	23	13	11	7	4.7	0.3	0.0
Upper Mississippi Valley							**32.0**	**−4.2**										**74**	**2.02**	**−0.4**										**6.4**		
Minneapolis	918	102	208	29.05	30.07		26.0	−3.6	60	23	34	−3	2	18	29				1.61	0.0	9	9,621	nw.	48	nw.	1	6	13	12	6.3	10.7	0.0
St. Paul	837	236	261	29.12	30.06	+.01	26.2	−2.9	62	23	34	−3	2	18	29				1.46	−0.1	9	9,913	nw.	52	nw.	1	10	12	9	5.2	12.7	0.0
La Crosse	714	11	48	29.25	30.05	+.01	26.8	−4.7	64	23	35	−2	13	18	31				0.83	−0.8	12	4,672	nw.	24	w.	1	7	7	17	6.8	8.8	3.5
Madison	974	70	78	28.96	30.06	+.02	25.8	−4.8	61	24	33	2	13	19	30	23	20	80	1.09	−1.1	12	8,093	nw.	48	ne.	31	8	4	19	6.9	10.4	8.1
Wausau	1,247	4		28.65	30.04		21.9		53	23	30	−11	13	14	32				1.82		11		n.				8	8	15	6.6	13.5	5.5
Charles City	1,015	10	49	28.96	30.08	+.03	28.4	−2.3	63	23	37	2	2	20	32	25	20	75	0.73	−1.2	9	6,591	nw.	30	nw.	1	7	11	13	5.9	4.7	T.
Davenport	606	71	79	29.39	30.07	+.04	31.0	−5.1	68	23	39	5	13	23	31	28	24	76	2.33	−0.1	8	6,988	nw.	32	nw.	1	6	9	16	6.6	16.8	7.6
Des Moines	861	84	97	29.15	30.08	+.04	33.3	−2.6	73	17	42	7	7	24	45	29	24	70	1.32	−0.3	10	6,543	n.	30	s.	17	6	9	16	6.5	9.5	2.0
Dubuque	700	81	96	29.27	30.05	+.01	29.2	−4.8	64	23	37	5	2	22	31	26	21	72	1.15	−1.1	8	6,206	nw.	29	nw.	1	5	6	20	7.3	12.9	8.0
Keokuk	614	64	78	29.39	30.09	+.06	34.8	−4.1	71	23	43	10	13	26	41	30	25	71	1.92	−0.4	11	7,447	nw.	36	nw.	1	6	9	16	6.7	17.9	10.5
Cairo	358	87	93	29.68	30.08	+.04	43.0	−4.2	77	24	52	20	14	34	37	36	29	64	2.79	−1.2	8	8,364	s.	42	sw.	31	8	8	15	6.1	T.	0.0
Peoria	609	11	45	29.39	30.07	+.04	32.0	−5.0	70	24	40	7	13	24	32	28	25	80	2.35	−0.6	13	6,816	nw.	32	nw.	1	6	11	14	6.1	18.2	6.0
Springfield, Ill	636	10	91	29.36	30.05	+.02	35.0	−5.2	73	24	43	9	13	27	28	31	27	79	3.57	+0.5	9	7,861	w.	32	w.	1	8	7	16	6.5	13.1	5.3
Hannibal	534	74	109	29.47	30.06	+.04	36.2	−4.8	72	23	44	11	13	28	37				3.14	+0.4	11	8,094	nw.	38	nw.	1	9	6	16	6.1	17.3	8.5
St. Louis	568	265	303	29.44	30.06	+.03	39.6	−4.2	80	24	47	15	13	32	32	34	28	68	3.95	+0.5	12	10,930	nw.	46	nw.	6	10	6	15	5.9	2.1	1.3
Missouri Valley							**36.7**	**−0.9**										**65**	**1.21**	**−0.7**										**4.9**		
Columbia, Mo.	784	11	84	29.21	30.07	+.04	37.8	−4.8	72	17	46	12	13	29	42				2.43	−0.6	12	8,049	nw.	46	nw.	1	10	5	16	5.8	8.9	4.5
Kansas City	963	161	181	29.03	30.10	+.08	39.8	−2.9	75	23	49	16	13	31	39	34	29	68	2.21	−0.6	11	10,671	nw.	46	nw.	1	13	9	9	4.7	12.4	7.5
St. Joseph	967	11	49	29.03	30.09		39.0		76	17	49	15	13	29	45	32	26	65	2.22		10	8,641	nw.	42	nw.	7	17	5	9	4.0	8.0	2.0
Springfield, Mo.	1,324	98	104	28.67	30.10	+.08	39.9	−5.3	71	23	48	18	13	32	32	34	28	68	2.51	−1.6	13	9,533	nw.	40	nw.	1	12	8	11	4.9	4.2	0.9
Iola	984	11	50	29.01	30.09	+.08	41.4	−3.1	77	17	52	18	27	31	42				1.90	−0.4	7	6,116	n.	27	w.	7	13	7	11	5.0	11.8	5.2
Topeka	987	92	107				40.3	−2.3	76	23	50	16	13	30	43				2.06	−0.2	10	8,894	n.	37	nw.	1	14	9	8	4.4	12.2	5.0
Drexel	1,299	10	54	28.66	30.09		34.6		75	23	45	10	13	24	44				0.73		4	9,092	nw.	34	nw.	24	12	7	12	5.4	6.0	T.
Lincoln	1,189	11	84	28.81	30.11	+.09	37.3	−0.2	77	23	48	14	27	26	45	31	24	64	0.76	−0.6	6	9,262	nw.	47	nw.	24	13	4	14	5.4	4.0	T.
Omaha	1,105	115	122	28.89	30.10	+.06	36.3	−0.7	77	23	45	12	7	27	44	30	23	62	0.90	−0.5	5	8,229	nw.	42	nw.	25	15	10	6	4.3	4.5	T.
Valentine	2,598	47	54	27.33	30.12	+.09	34.2	+1.9	73	23	46	5	7	22	44	28	20	63	0.82	−0.4	9	8,305	nw.	48	nw.	24	9	17	5	4.7	11.1	0.0
Sioux City	1,135	94	104	28.87	30.13	+.08	33.9	+1.2	75	23	44	4	7	24	39	28	22	68	0.32	−0.9	5	10,840	n.	52	nw.	24	10	12	9	5.2	1.2	0.0
Huron	1,306	59	74	28.70	30.15	+.09	30.8	+1.9	72	23	42	−1	7	20	43	25	19	67	0.13	−0.9	2	8,379	nw.	46	nw.	24	13	9	9	4.7	1.6	0.0
Pierre	1,572	70	75	28.43	30.14	+.09	34.5	+3.0	75	23	46	5	7	23	39	28	19	60	0.03	−1.3	2	8,530	nw.	47	w.	24	10	10	11	5.3	0.3	0.0
Yankton	1,233	49	57	28.76	30.12	+.07	34.0	+0.8	75	23	45	3	7	23	38				0.50	−0.6	5	7,639	nw.	46	nw.	24	10	10	11	5.4	2.2	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, March, 1926*—Continued

Districts and stations	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
Northern Slope							34.4	+3.1										62	0.50	−0.6										5.2		
Billings	3,140	5					37.6		71	16	52	3	29	23	47				0.44		2		nw.				20	5	6			
Havre	2,505	11	44	27.44	30.13	+.13	34.8	+7.7	70	22	48	7	31	22	43	30	23	66	0.14	−0.3	4	5,595	sw.	40	nw.	23	16	9	6	3.8	1.4	0.0
Helena	4,110	87	112	25.86	30.13	+.12	37.4	+5.0	64	16	47	10	29	28	33	31	22	57	0.17	−0.6	4	6,723	sw.	39	sw.	22	8	9	14	6.2	1.9	0.0
Kalispell	2,973	48	56	27.00	30.11	+.12	38.6	+5.7	63	22	48	21	25	29	30	33	25	62	0.20	−0.9	4	4,101	nw.	30	sw.	23	13	12	6	4.5	1.2	0.0
Miles City	2,371	48	55	27.56	30.18	+.16	35.5	+6.9	72	16	47	10	31	24	45	29	22	60	0.10	−0.7	5	5,410	nw.	48	nw.	23	11	10	10	4.8	0.5	0.0
Rapid City	3,259	50	58	26.64	30.16	+.15	33.6	+1.0	70	23	45	5	7	22	40	28	20	60	0.22	−0.8	10	7.528	nw.	44	nw.	24	7	13	11	5.7	2.2	T.
Cheyenne	6,088	84	101	23.97	30.09	+.13	31.8	−1.3	62	17	42	7	31	22	34	26	20	66	1.04	+0.1	11	9,776	n.	50	w.	23	7	10	14	6.3	5.5	0.4
Lander	5,372	60	68	24.66	30.13	+.14	32.0	−0.4	64	23	44	−1	29	20	38	27	20	64	1.49	−0.1	7	3,165	sw.	40	ne.	23	9	14	8	5.4	15.9	0.8
Sheridan	3,790	10	47	26.15	30.15		34.9		70	16	47	2	31	22	46	28	21	63	0.94		13	4,811	nw.	30	nw.	23	9	15	7	4.9	8.8	T.
Yellowstone Park	6,241	11	48	23.88	30.15	+.13	29.2	+2.7	59	22	40	−3	29	18	36	24	17	61	0.56	−1.6	13	5,398	s.	36	nw.	4	7	17	7	5.1	5.8	1.4
North Platte	2,821	11	51	27.13	30.13	+.13	37.0	+0.4	77	23	50	8	7	24	41	29	21	60	0.54	−0.3	9	6,262	nw.	42	nw.	24	12	7	12	5.0	3.9	T.
Middle Slope							40.9	−2.4										65	1.70	+0.2										5.1		
Denver	5,292	106	113	24.73	30.09	+.14	37.6	−1.7	71	23	48	10	31	27	38	31	24	68	1.98	+1.0	15	5.771	s.	44	n.	5	10	7	14	5.5	13.3	0.7
Pueblo	4,685	80	86	25.28	30.03	+.11	39.2	−2.4	75	23	52	−1	30	26	44	32	23	59	1.10	+0.2	11	4,445	n.	28	e.	12	11	8	12	5.3	6.5	0.0
Concordia	1,392	50	58	28.61	30.12	+.11	39.5	−1.5	77	23	50	15	13	29	36	33	25	62	0.88	−0.6	8	7.326	nw.	36	nw.	24	13	6	12	4.9	2.8	T.
Dodge City	2,509	11	51	27.46	30.12	+.15	40.6	−2.2	75	23	52	8	31	29	38	34	28	70	2.27	+1.4	10	8,256	ne.	38	nw.	24	18	3	10	4.2	10.3	3.0
Wichita	1,358	139	158	28.62	30.08	+.09	42.1	−3.0	73	23	52	18	13	33	36	36	29	64	2.16	−0.1	9	11,067	s.	42	sw.	17	12	10	9	4.7	8.8	4.0
Broken Arrow	765	11	56	29.24	30.08		45.3		75	23	54	23	13	36	38				1.84		8	10,761	n.	42	n.	24	11	4	16	5.9	1.5	T.
Oklahoma City	1,214	10	47	28.78	30.08	+.10	46.5	−3.5	79	19	55	20	31	38	34	40	34	60	1.81	−0.6	7	8,684	n.	34	se.	9	8	10	13	6.1	1.6	T.
Southern Slope							50.6	−3.9										62	2.21	+1.2										5.6		
Abilene	1,738	10	52	28.23	30.06	+.10	52.2	−4.3	82	19	62	26	30	42	37	45	38	66	3.65	+2.3	12	7,599	s.	30	w.	10	10	5	16	5.9	0.4	0.0
Amarillo	3,676	10	49	26.28	30.06	+.11	43.6	−3.3	77	18	54	13	31	33	38	36	29	62	1.67	+1.0	8	8,245	s.	30	nw.	24	7	13	11	5.6	13.0	2.5
Del Rio	944	64	71	29.04	30.04	+.09	60.2	−3.3	83	21	68	36	31	52	32				1.92	+0.8	11	7,510	se.	40	n.	25	8	10	13	6.2	0.0	0.0
Roswell	3,566	75	85	26.36	30.00	+.10	46.5	−4.8	75	18	59	15	30	34	41	39	30	50	1.59	+0.9	8	5,828	s.	31	n.	29	16	4	11	4.7	5.5	0.0
Southern Plateau							52.6	+1.8										53	0.94	+0.4										3.9		
El Paso	3,778	152	175	26.17	29.97	+.09	53.6	−2.2	77	23	65	28	30	42	34	43	31	51	1.49	+1.1	14	6,010	w.	52	w.	29	13	14	4	4.2	0.2	0.0
Santa Fe	7,013	38	53	23.18	29.96	+.07	38.4	−1.3	60	23	49	8	30	28	28	31	23	61	1.31	+0.6	11	4,739	se.	28	w.	9	10	10	11	5.4	6.7	T.
Flagstaff	6,907	10	59	23.30	29.92	+.01	37.8	+1.9	62	24	50	10	11	26	36	31		66	2.54		10	5,375	w.	33	w.	29	10	17	4		6.5	T.
Phoenix	1,108	10	82	28.76	29.92	+.01	63.9	+3.2	87	14	77	38	11	51	37	50	37	44	1.63	+1.1	8	3,647	e.	25	nw.	25	11	14	6	4.5	0.0	0.0
Yuma	141	9	54	29.77	29.92	−.02	66.8	+2.7	90	23	81	40	30	53	40	53	41	45	0.06	−0.3	1	3,948	w.	30	nw.	29	23	7	1	2.1	0.0	0.0
Independence	3,957	5	25	25.95	29.96	+.02	55.0	+6.5	80	23	70	30	9	40	40	40			0.21	−0.3	2		nw.				14	12	5	3.4	0.0	0.0
Middle Plateau							43.8	+2.9										50	0.52	−0.6										3.8		
Reno	4,532	74	81	25.50	30.04	+.06	46.8	+5.8	73	23	62	25	25	32	39	37	25	47	0.35	−0.5	1	4,206	w.	36	w.	31	21	9	1	2.4	5.0	0.0
Tonopah	6,090	12	20				44.9		66	23	54	21	10	35	28	35	21	41	0.06		1		nw.									
Winnemucca	4,344	18	56	25.67	30.09	+.08	43.4	+3.4	72	15	60	16	29	27	43	35	26	54	0.05	−0.9	2	4,973	ne.	25	s.	16	20	11	0	3.1	0.3	0.0
Modena	5,479	10	43	24.60	29.98	+.02	40.7	+2.5	69	23	56	11	6	25	44	32	20	51	0.96	−0.3	7	6,749	w.	50	sw.	31	14	7	10	4.1	6.5	0.0
Salt Lake City	4,360	163	203	25.64	30.04	+.06	44.1	+2.4	67	23	53	22	29	36	28	36	26	50	0.60	−1.4	4	5,265	nw.	37	sw.	17	15	6	10	4.6	2.2	0.0
Grand Junction	4,602	60	68	25.36	29.96	+.02	44.0	+0.4	69	23	56	22	29	32	34	36	26	55	0.65	−0.1	10	4,232	se.	35	nw.	5	14	9	8	4.8	1.1	0.0
Northern Plateau							45.1	+3.6										58	0.76	−0.8										4.7		
Baker	3,471	48	53		30.15	+.12	41.8	+4.2	69	22	54	20	6	30	36			64	0.81	−0.6	6	4,271	se.	26	nw.	31	17	7	7		T.	0.0
Boise	2,739	78	86	27.24	30.13	+.10	45.6	+2.9	71	15	57	26	29	34	34	38	28	53	0.51	−0.9	2	3,804	nw.	31	n.	28	17	8	6	3.6	T.	0.0
Lewiston	757	40	48	29.35	30.17	+.14	47.8	+2.4	73	15	60	27	6	36	34				0.97	−0.3	8	1,969	e.	24	ne.	31	8	12	11	5.6	0.0	0.0
Pocatello	4,477	60	68	25.50	30.07	+.06	40.4	+3.0	65	16	52	10	29	29	31	33	24	58	0.77	−1.0	7	5,773	se.	40	sw.	23	10	10	11	5.3	2.7	1.0
Spokane	1,929	101	110	28.07	30.15	+.14	44.4	+4.7	66	15	56	24	6	33	32	38	30	61	0.58	−0.9	5	3,674	s.	22	sw.	23	10	14	7	5.0	0.3	0.0
Walla Walla	991	57	65	29.06	30.14	+.12	50.6	+4.5	73	15	60	32	6	41	30	43	34	56	0.92	−1.0	8	3,201	s.	23	w.	23	15	10	6	4.1	0.0	0.0
North Pacific Coast Region							50.8	+5.6										74	1.38	−3.1										4.9		
North Head	211	11	56	29.94	30.18	+.17	50.0	+4.8	76	14	55	40	7	45	25	47	44	82	2.50	−2.8	13	9,886	s.	48	s.	12	9	7	15	6.7	0.0	0.0
Port Angeles	29	8	53		30.17		46.2		60	29	54	32	6	39	24				0.27	−1.9	5	4,391	sw.	38	nw.	30	7	15	9		0.0	0.0
Seattle	125	215	250	30.03	30.16	+.17	50.4	+5.5	71	14	58	35	5	43	32	46	41	72	0.85	−1.9	13	5,110	s.	35	sw.	22	11	9	11	5.2	0.0	0.0
Tacoma	194	172	201	29.95	30.16	+.16	50.0	+5.8	70	29	58	32	7	42	35				0.65	−2.9	11	4,804	n.	30	w.	15	9	11	11	5.4	0.0	0.0
Tatoosh Island	86	9	53	30.06	30.15	+.19	48.6	+5.7	61	14	52	42	6	45	13	46	45	89	4.51	−4.1	13	10,421	e.	62	e.	14	10	10	11	5.6	0.0	0.0
Yakima	1,071	5					49.0		76	29	66	22	6	32	43				0.02		1		nw.				13	12	6	4.5	0.0	0.0
Medford	1,425	4					51.1		83	14	69	26	10	33	52	43	36	62	T.		0		se.				13	8	10	2.9	0.0	0.0
Portland, Oreg.	153	68	106	29.90	30.15	+.13	53.5	+6.6	76	14	63	35	7	30	44	48	42	69	0.80	−3.9	9	3,963	nw.	23	sw.	12	11	8	12	5.5	0.0	0.0
Roseburg	510	9	57	29.60	30.15	+.11	52.0	+4.9	82	14	65	32	24	39	40	47	42	72	0.06	−3.9	5	2,025	nw.	16	n.	26	14	14	3	3.6	0.0	0.0
Middle Pacific Coast Region							57.9	+5.6										68	0.14	−3.8										3.4		
Eureka	62	73	89	30.06	30.13	+.07	51.5	+3.2	73	13	58	40	21	45	26	48	46	81	0.07	−6.9	3	4,357	n.	30	n.	20	11	10	10	5.0	0.0	0.0
Point Reyes	490	7	18	29.46	29.98		54.6	+5.0	76	13	60	47	1	50	23				0.13		1	12,025	nw.	50	nw.	20	15	8	8	4.4	0.0	0.0
Red Bluff	332	50	56	29.67	30.02	−.02	61.4	+7.8	89	22	74	37	10	49	39	51	41	54	0.20	−3.6	1	4,617	nw.	29	n.	24	24	5	2	2.1	0.0	0.0
Sacramento	69	106	117	29.93	30.00	−.02	60.2	+5.9	82	22	71	43	10	49	31	53	47	65	0.05	−3.0	1	5,741	s.	27	s.	31	25	6	0	1.7	0.0	0.0
San Francisco	155	208	243	29.86	30.03	−.03	60.6	+6.4	83	22	68	49	10	53	26	53	48	72	0.25	−2.9	2	5,919	w.	32	nw.	15	18	10	3	3.2	0.0	0.0
San Jose	141	12	110	29.87	30.02		59.0	+5.3	84	24	71	38	10	47	38				0.12	−2.5	2	4,121	nw.	20	sw.	31	16	5	10	4.2	0.0	0.0
South Pacific Coast Region							61.4	+5.5										65	0.34	−2.3										4.7		
Fresno	327	89	98	29.65	30.01	.00	60.9	+5.9	85	23	73	42	10	49	33	52	43	58	0.01	−1.8	1	4,076	nw.	23	nw.	17	21	6	4	2.8	0.0	0.0
Los Angeles	338	159	191	29.63	30.00	−.02	63.0	+5.5	88	23	71	50	11	55	30	54	47	63	0.22	−2.8	3	3,826	e.	18	sw.	9	6	15	10	5.6	0.0	0.0
San Diego	87	62	70	29.90	30.00	−.02	62.4	+5.7	88	23	69	50	11	56	33	55	50	69	0.82	−0.9	2	4,436	w.	20	nw.	22	7	16	8	5.6	0.0	0.0
San Luis Obispo	201	32	40	29.83	30.05	−.01	59.5	+4.8	90	23	70	41	8	49	44	52	47	71	0.33	−3.6	5	2,763	nw.	20	ne.	21	11	11	9	4.8	0.0	0.0
West Indies																																
San Juan, P. R.	82	9	54	29.93	30.01		76.5	+1.1	89	12	82	67	14	71	19				1.70	−1.4	8	8,129	e.	37	e.	1	14	11	6	4.3	0.0	0.0
Panama Canal																																
Balboa Heights	118	7	97	29.75	29.88	+.01	82.0	+0.8	94	31	91	70	24	73	23	73	71	73	0.00	−0.6	0	9,504	nw.	33	n.	16	4	26	1	5.1	0.0	0.0
Colon	38	7	97	29.86	29.90	+.02	81.6	+1.0	87	14	86	72	25	77	13	75	73	77	0.43	−1.0	11	11,623	n.	29	nw.	18	4	18	9	6.2	0.0	0.0
Alaska																																
Juneau	80	11	54				40.8		54	30	45	32	24	37	19	38	37	91	8.71		27	5,158	s.	32	se.	18	0	3	28	9.5	0.1	0.0
Hawaiian Islands																																
Honolulu	38	86	100				72.6		80	12	78	61	29	68	13	64	60	67	1.20	−2.0	10	6,950	e.	34	sw.	26	8	16	7	5.1	0.0	0.0

TABLE 2.—*Data furnished by the Canadian Meteorological Service, March, 1926*

Station	Altitude above mean sea level, Jan. 1, 1919	Pressure: Station reduced to mean of 24 hours	Pressure: Sea level reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Mean maximum	Temperature of the air: Mean minimum	Temperature of the air: Highest	Temperature of the air: Lowest	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Total snowfall
	Feet	*Inches*	*Inches*	*Inches*	°*F*	°*F*	°*F*	°*F*	°*F*	°*F*	*Inches*	*Inches*	*Inches*
St. Johns, N. F	125												
Sydney, C. B. I	48	29.75	29.80	−.08	25.5	−0.7	33.9	17.1	48	−1	5.04	+0.11	17.0
Halifax, N. S	88	29.71	29.82	−.12	27.9	−1.1	35.7	20.1	51	2	5.59	+0.13	14.1
Yarmouth, N. S	65	29.73	29.80	−.15	28.5	−2.3	34.4	22.7	44	11	5.19	+0.34	25.4
Charlottetown, P. E. I	38	29.73	29.77	−.13	23.1	−2.3	30.5	15.7	46	−8	4.25	+1.04	28.1
Chatham, N. B	28	29.69	29.72	−.18	19.4	−3.6	30.4	8.3	53	−25	3.43	−0.04	28.8
Father Point, Que	20	29.80	29.83	−.07	16.4	−3.9	24.5	8.3	43	−11	2.98	+0.25	29.4
Quebec, Que	296	29.56	29.89	−.07	20.2	−1.0	27.3	13.2	40	−5	3.09	−0.17	29.6
Montreal, Que	187	29.68	29.90	−.10	21.8	−2.0	28.1	15.6	44	0	4.03	+0.24	36.0
Stonecliffe, Ont	489												
Ottawa, Ont	236	29.68	29.96	−.05	21.7	+0.2	31.1	12.4	46	−11	3.44	+0.72	34.4
Kingston, Ont	285	29.62	29.95	−.06	23.9	−1.7	31.3	16.5	44	−6	2.31	−0.33	10.9
Toronto, Ont	379	29.54	29.97	−.05	26.1	−1.2	32.0	20.1	48	−1	2.90	+0.26	8.6
Cochrane, Ont	930				11.5		21.1	1.8	48	−19	0.60		6.0
White River, Ont	1,244	28.64	30.02	−.01	8.9	−3.3	22.5	−4.6	46	−35	1.16	−0.22	11.6
Port Stanley, Ont	592												
Southampton, Ont	656	29.23			19.1	−5.6	27.8	10.4	44	−14	3.03	+0.38	24.4
Parry Sound, Ont	688	29.24	29.97	−.05	18.5	−2.6	27.2	9.9	43	−16	3.87	+1.64	37.5
Port Arthur, Ont	644	29.34	30.07	+.02	17.0	+0.2	25.3	8.7	43	−14	0.57	−0.40	4.1
Winnipeg, Man	760	29.28	30.15	+.06	17.4	+5.1	26.7	8.1	57	−2	0.63	−0.40	6.0
Minnedosa, Man	1,690	28.24	30.14	+.08	17.3	+4.8	27.4	7.2	55	−22	0.34	−0.31	3.4
Le Pas, Man	860				11.6		23.9	−0.8	53	−30	0.65		6.5
Qu'Appelle, Sask	2,115	27.78	30.12	+.08	21.1	+6.2	30.4	11.9	57	−22	0.61	−0.16	2.8
Medicine Hat, Alb	2,144	27.75	30.05	+.05	36.7	+9.2	48.3	25.2	66	5	0.27	−0.49	0.6
Moose Jaw, Sask	1,759				27.4		37.3	17.6	61	−3	0.41		1.1
Swift Current, Sask	2,392	27.55	30.15	+.13	29.6	+7.6	38.7	20.5	60	4	0.31	−0.50	2.1
Calgary, Alb	3,428	26.47	30.11	+.16	34.9	+8.7	46.4	23.4	68	15	0.51	−0.21	5.1
Banff, Alb	4,521	25.41	30.07	+.13	33.2	+13.0	44.8	21.7	59	8	0.41	−1.00	2.5
Edmonton, Alb	2,150	27.72	30.06	+.10	30.3	+6.1	39.9	20.7	57	−5	0.89	+0.17	8.3
Prince Albert, Sask	1,450	28.54	30.18	+.10	21.4	+9.4	32.4	10.5	58	−12	0.06	−0.71	0.6
Battleford, Sask	1,592	28.34	30.15	+.09	24.7	+11.6	36.4	13.1	56	0	0.18	−0.28	0.4
Kamloops, B. C	1,262	28.85	30.17	+.25	44.6	+8.5	56.1	33.1	68	22	0.20	−0.37	0.0
Victoria, B. C	230	29.91	30.17	+.20	49.3	+7.4	55.9	42.8	63	38	0.57	−2.55	0.0
Barkerville, B. C	4,180	25.72	30.10	+.22	31.6	+5.5	40.2	23.0	52	12	1.93	+0.04	14.2
Triangle Island, B. C	680												
Prince Rupert, B. C	170				44.4		52.1	36.6	68	29	7.44		0.0
Hamilton, Ber	151	29.91	30.08	.00	60.2	−2.0	66.8	53.6	74	45	6.08	+0.95	0.0

LATE REPORTS, FEBRUARY, 1926

Station	Altitude above mean sea level, Jan. 1, 1919	Pressure: Station reduced to mean of 24 hours	Pressure: Sea level reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Mean maximum	Temperature of the air: Mean minimum	Temperature of the air: Highest	Temperature of the air: Lowest	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Total snowfall
St. Johns, N. F	125	29.33	29.47	−.36	21.5	−0.5	27.4	15.6	38	0	4.48	−0.43	26.9
Sydney, C. B. I	48	29.62	29.67	−.25	17.7	−1.6	27.3	8.0	43	−12	6.48	+2.39	41.0
Halifax, N. S	88	29.58	29.69	−.26	21.4	−1.0	29.1	13.7	43	−3	5.64	+0.48	34.2
Yarmouth, N. S	65	29.60	29.67	−.32	23.8	−2.0	29.5	18.2	42	6	5.44	+0.70	38.1
Charlottetown, P. E. I	38	29.64	29.68	−.27	15.6	−2.0	23.1	8.2	40	−13	2.94	−0.12	29.1
Chatham, N. B	28	29.63	29.67	−.29	12.7	+0.2	21.8	3.6	39	−26	2.88	−0.28	28.8
Calgary, Alb	3,428	26.26	29.92	−.07	28.2	+14.7	40.1	16.4	58	−8	0.94	+0.31	9.4
Kamloops, B. C	1,262	28.63	29.95	−.01	37.4	+9.1	43.9	30.8	61	21	0.70	−0.09	1.0
Barkerville, B. C	4,180	25.45	29.80	−.11	26.6	+7.7	33.1	20.1	40	4	3.93	+0.87	38.0

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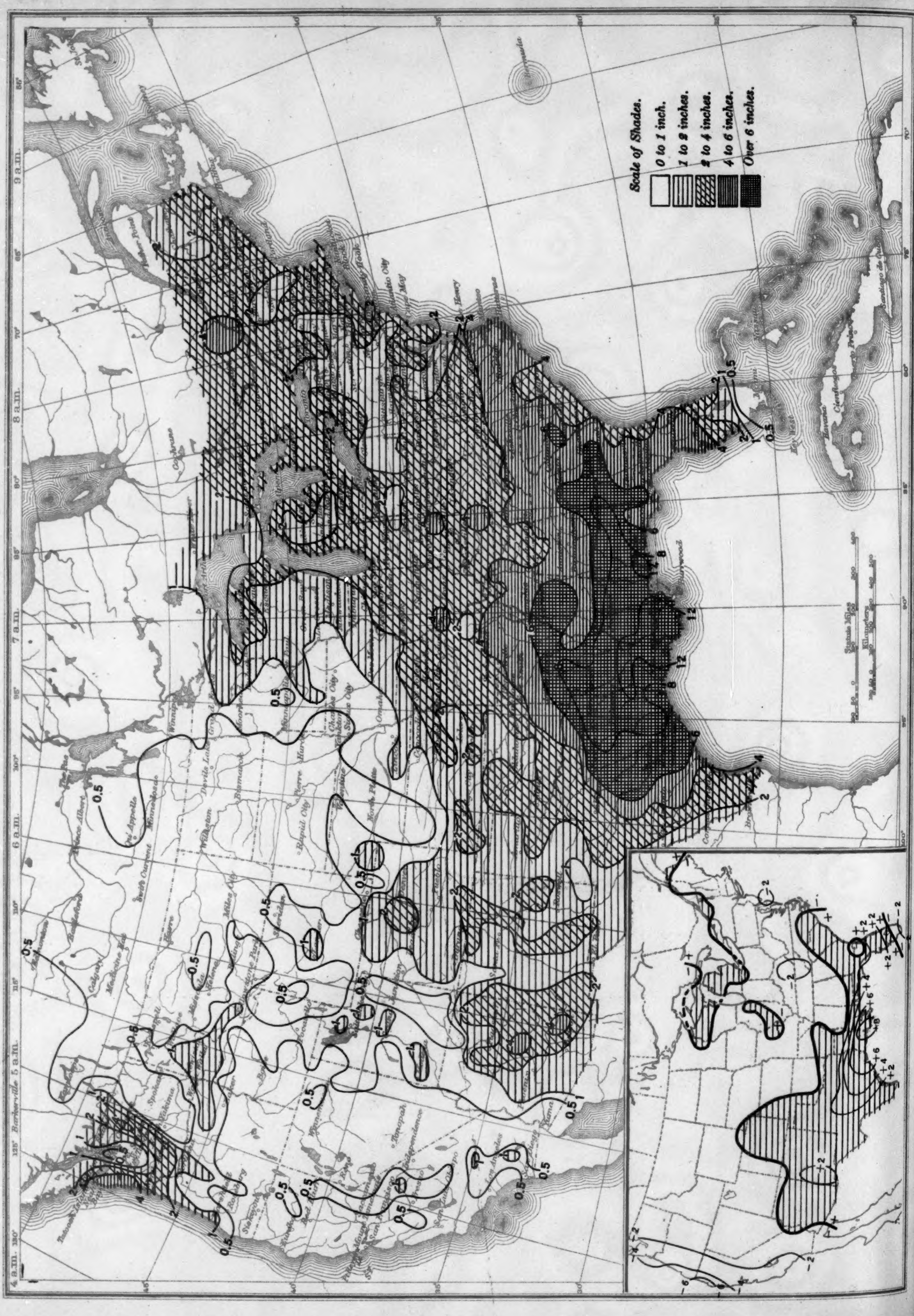
(Plotted by Wilfred P. Day)

Chart II. Tracks of Centers of Cyclones, March, 1926. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by Wilfred P. Day)


Shaded portions show excess (+).
Unshaded portions show deficiency (—).
Lines show amount of excess or deficiency.

Chart IV. Total Precipitation, Inches, March, 1926. (Inset) Departure of Precipitation from Normal



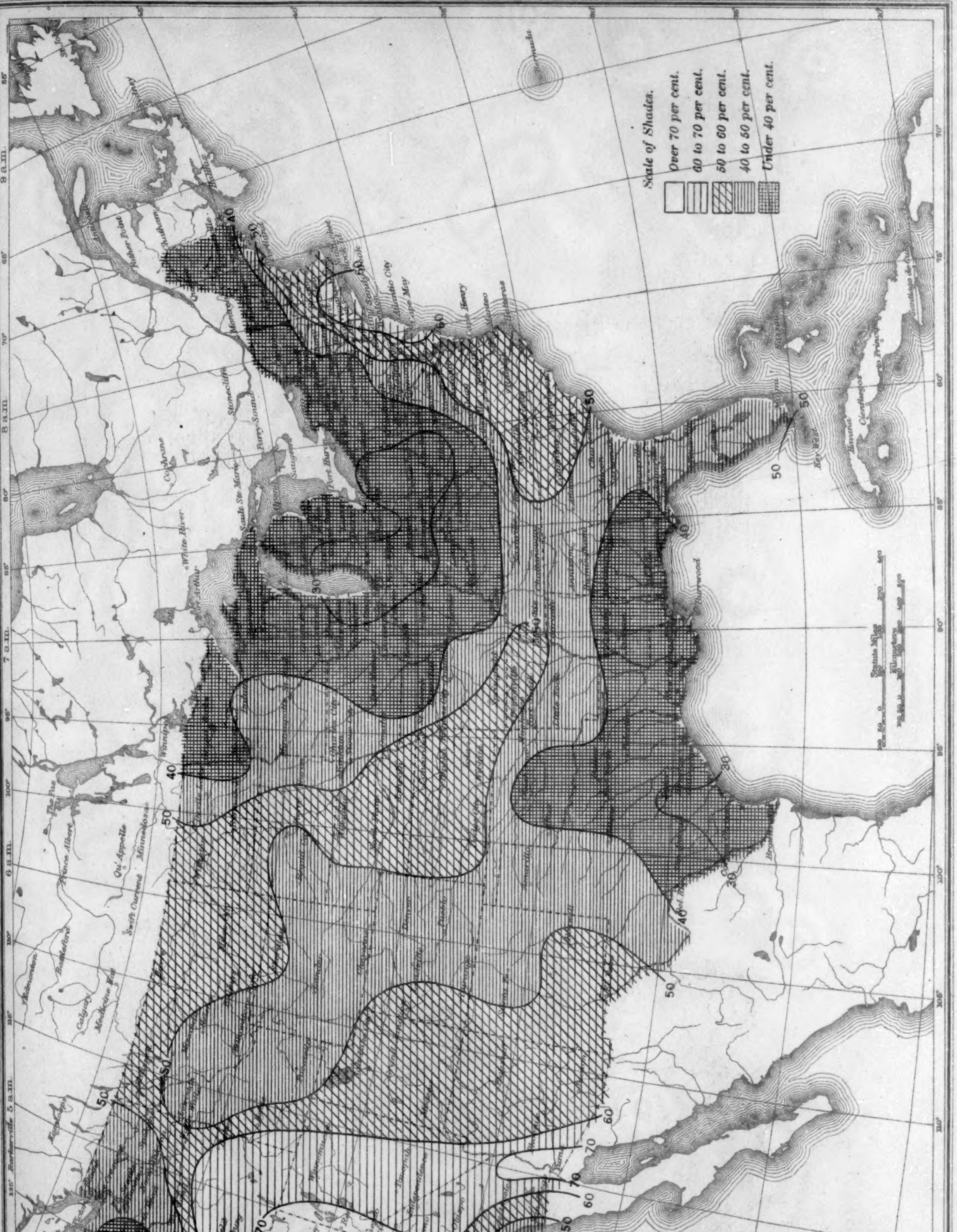
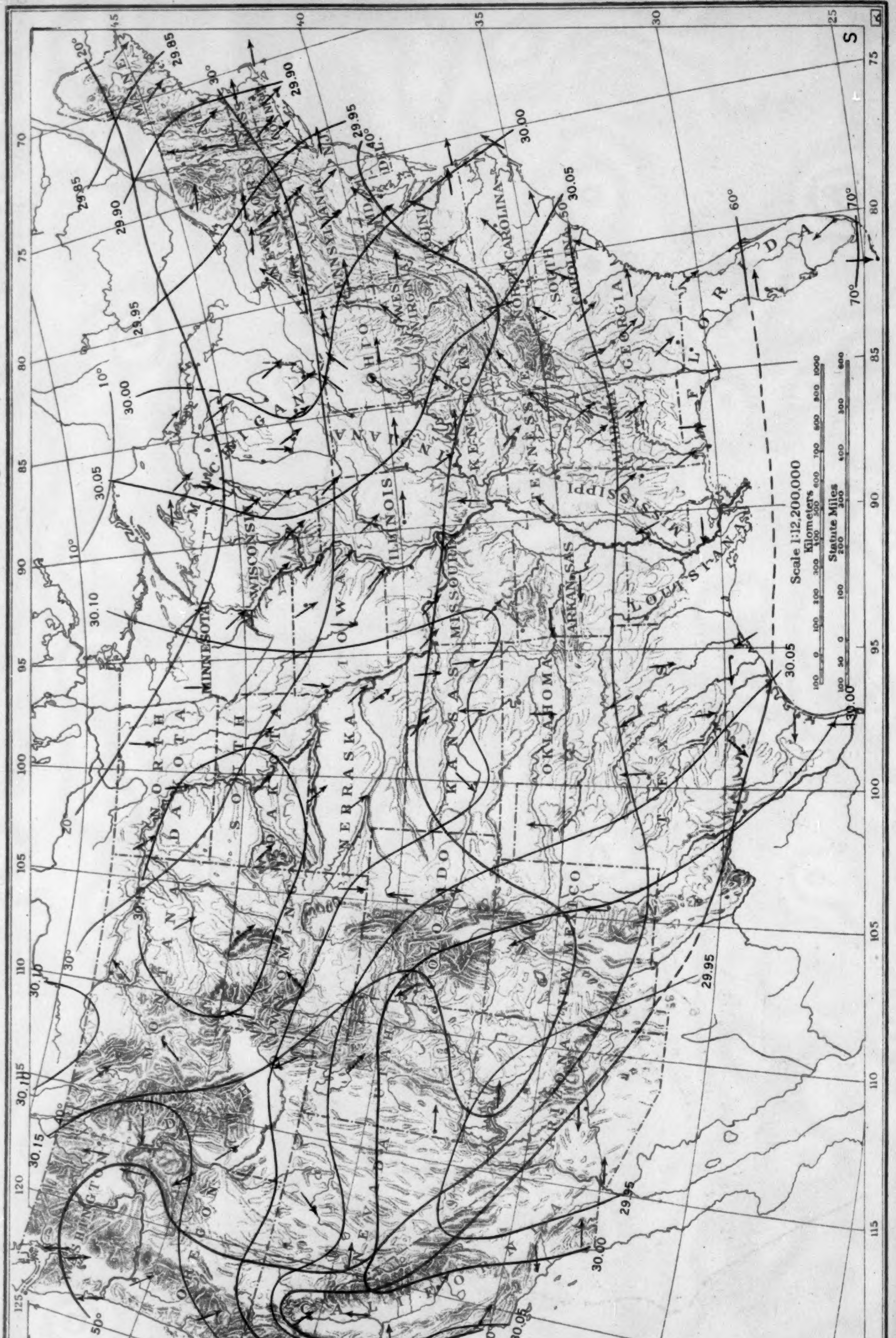
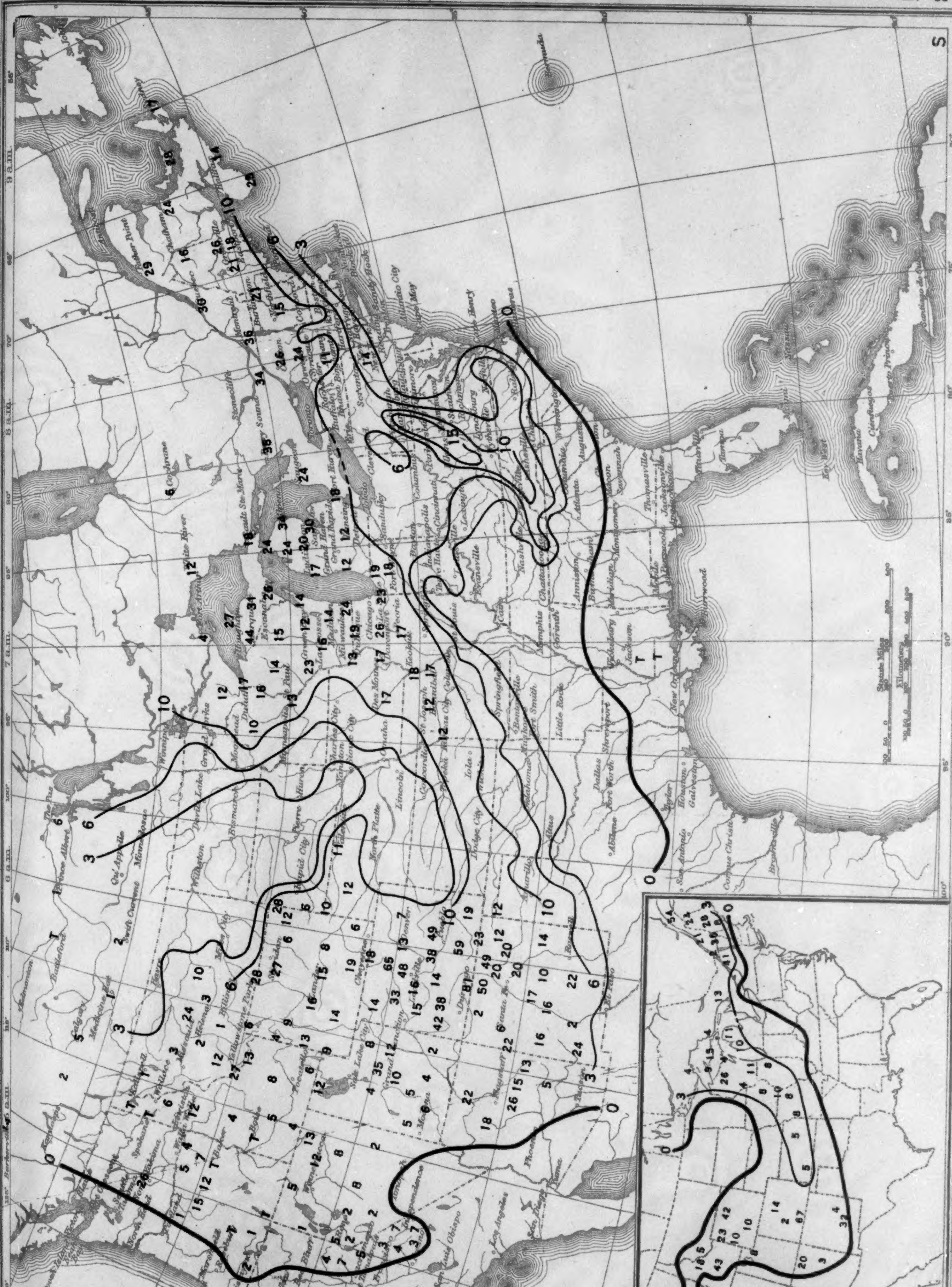


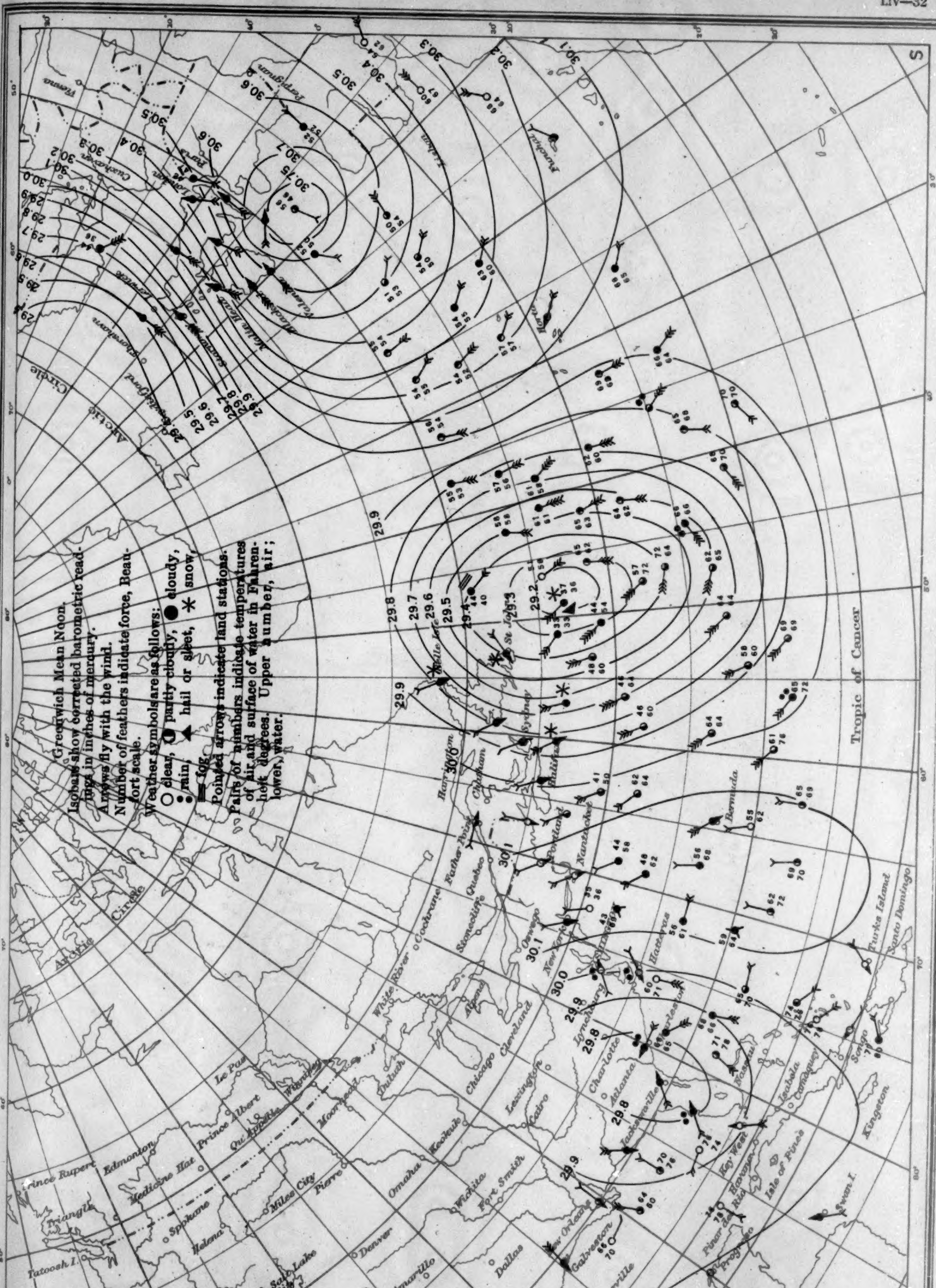
Chart V. Percentage of Clear Sky between Sunrise and Sunset, March, 1926

Chart VI. Isobars at Sea level and Isotherms at Surface; Prevailing Winds, March, 1926



Depth of Snow on Ground at End of Month





(Plotted by F. A. Young)

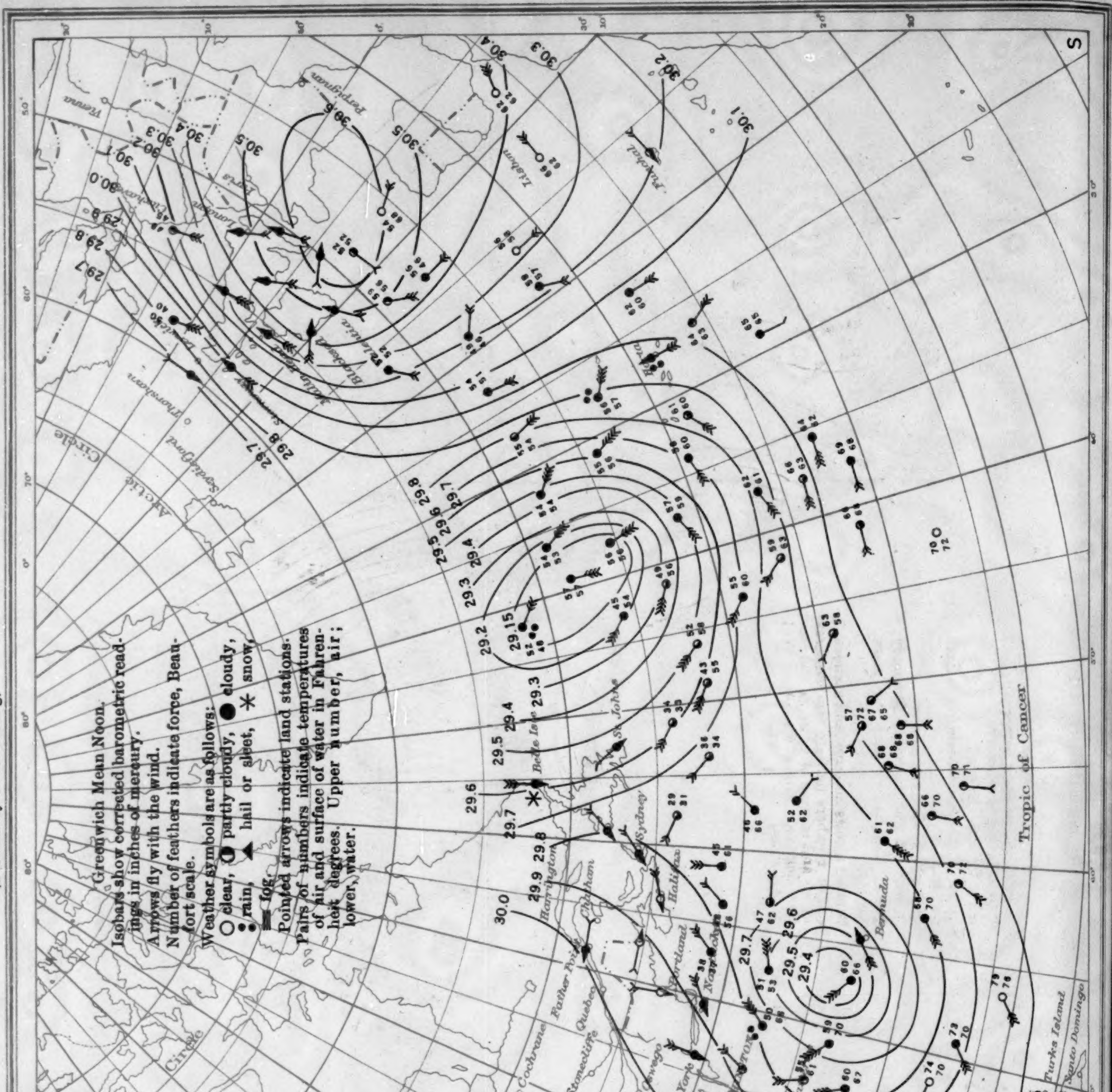


Chart IX. Weather Map of North Atlantic Ocean, March 12, 1926
(Plotted by F. A. Young)

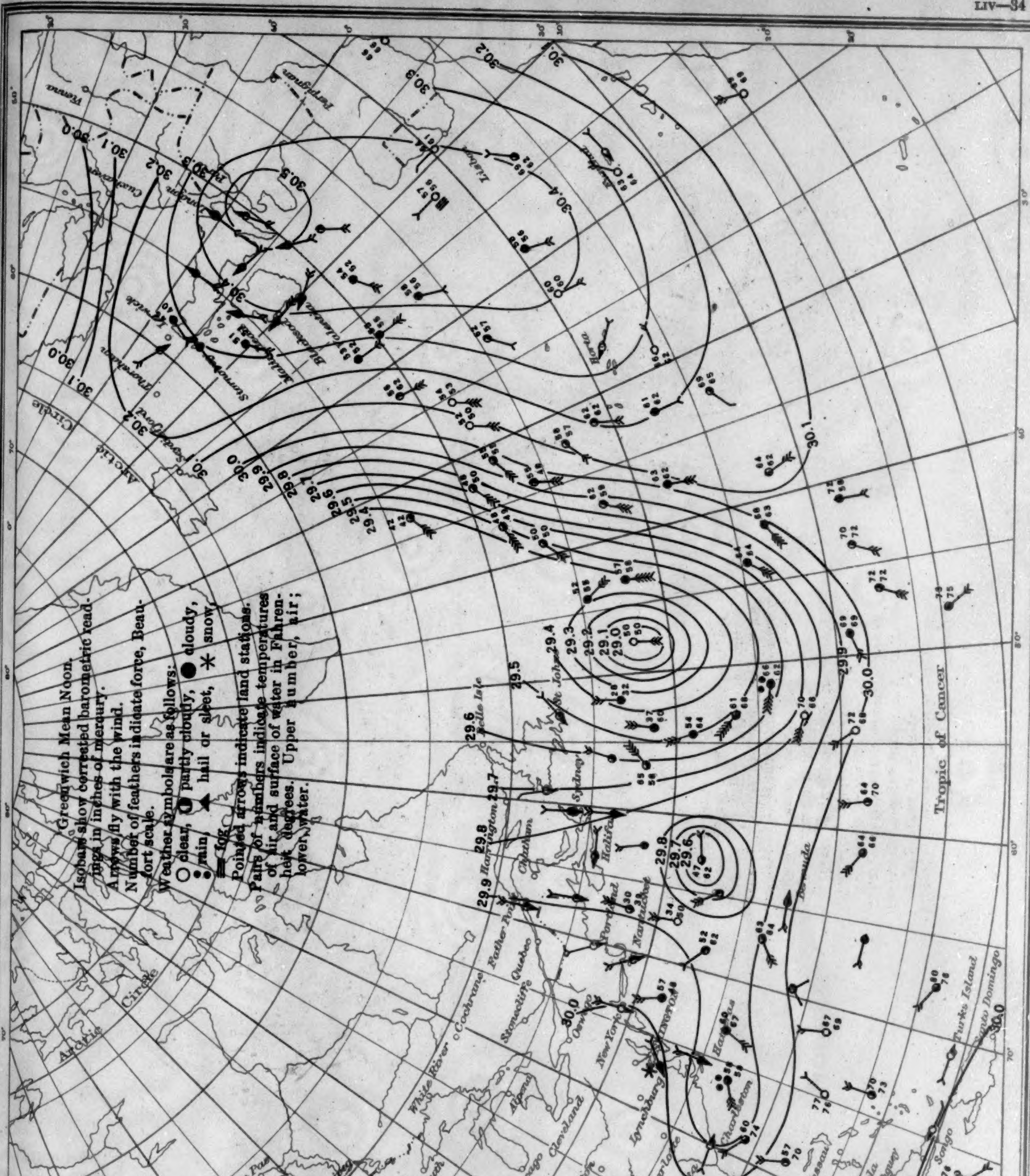
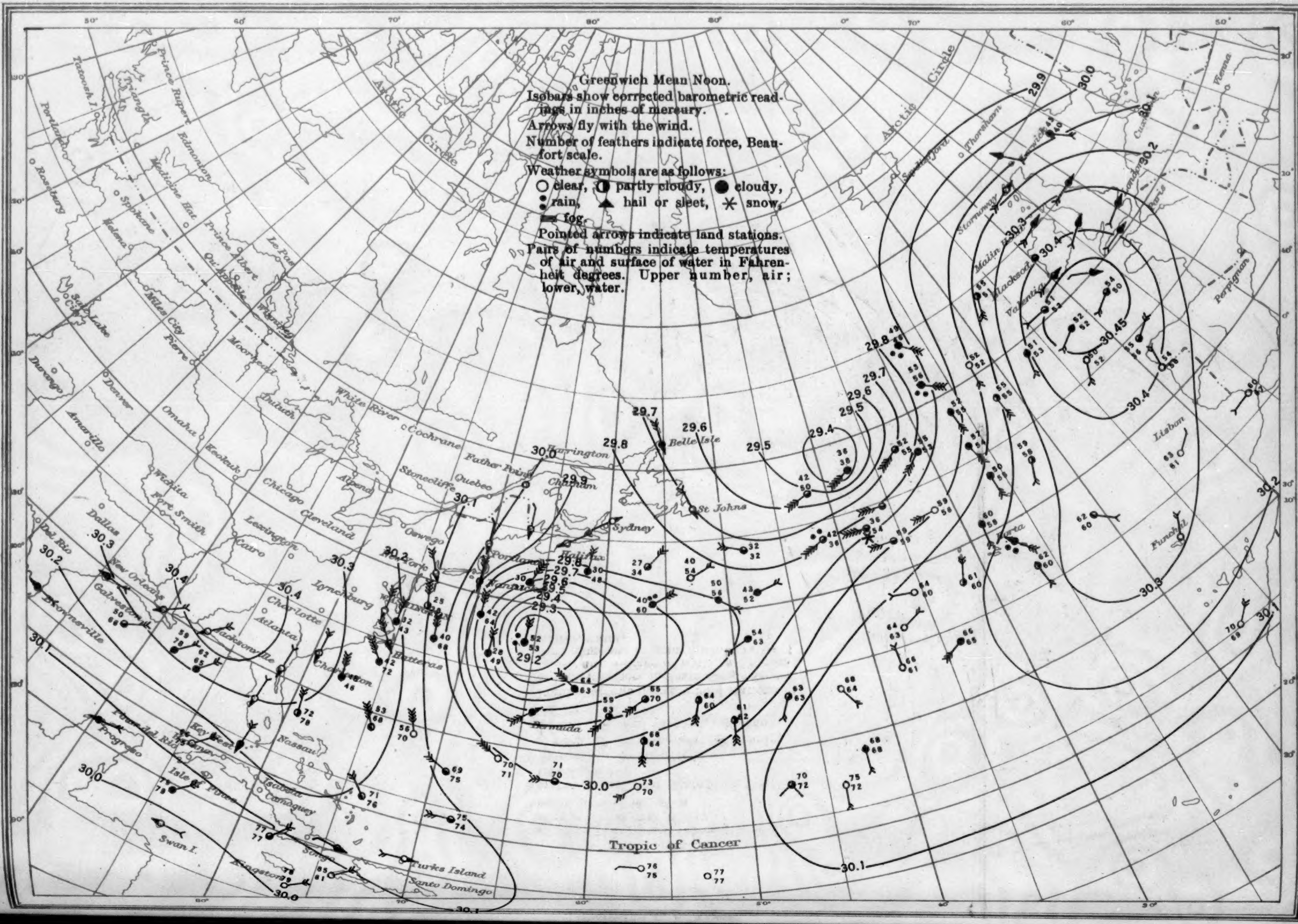

(Plotted by F. A. Young)
Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows:
○ clear, ◐ partly cloudy, ● cloudy, ⁚ rain, ▲ hail or sleet, * snow, ≡ fog.
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Arctic Circle
Tropic of Cancer

Chart XI. Weather Map of North Atlantic Ocean, March 14, 1926

(Plotted by F. A. Young)



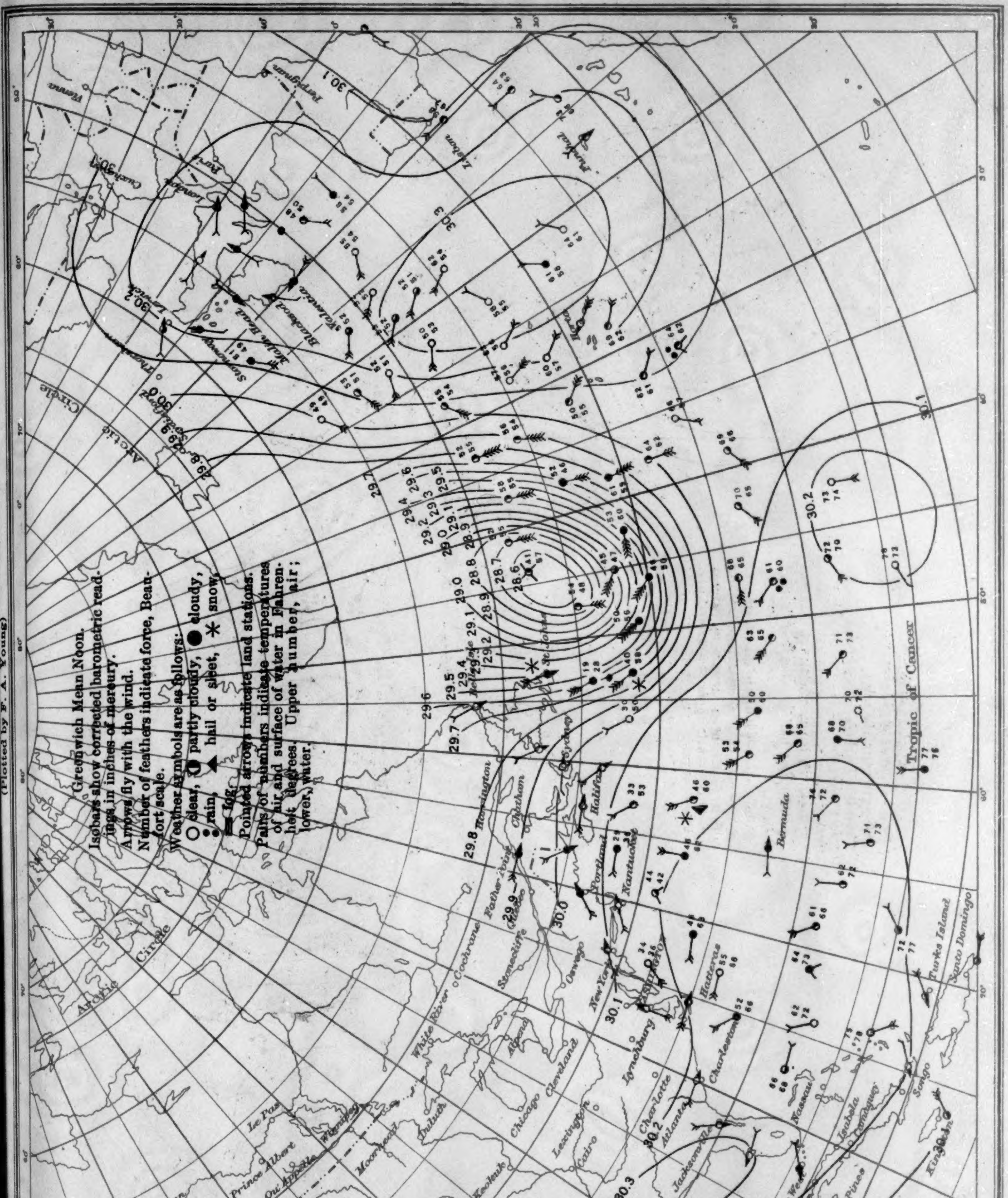

(Plotted by F. A. Young)
Greenwich Mean Noon.
Isobars show corrected barometric readings in inches of mercury.
Arrows fly with the wind.
Number of feathers indicate force, Beaufort scale.
Weather symbols are as follows:
clear, partly cloudy, cloudy,
rain, hail or sleet, snow,
fog.
Pointed arrows indicate land stations.
Pairs of numbers indicate temperatures of air and surface of water in Fahrenheit degrees. Upper number, air; lower, water.
Arctic Circle
Tropic of Cancer
Bermuda
Halifax
Nantucket
Portland
New York
Hatteras
Charleston
Jacksonville
Key West
Havana
Nassau
New Orleans
Galveston
Brownsville
Del Rio
Dallas
Fort Smith
Wichita
Omaha
Pierre
Denver
Amarillo
Durango
Salt Lake City
Helena
Spokane
Roseburg
Portland
Tatoosh I.
Triangle
Prince Rupert
Edmonton
Medicine Hat
Prince Albert
Qu'Appelle
Winnipeg
Le Pas
Moorhead
Duluth
Chicago
Cleveland
Lexington
Cairo
Keokuk
Miles City
White River
Cochrane
Father Point
Chatham
Harrington
Belle Isle
St. Johns
Sydney
Oswego
Alpena
Stonecliffe
Lynchburg
Charlotte
Atlanta
Isle of Pines
Swan I.
Kingston
Santo Domingo
Turks Island
Isabela
Progreso
Lisbon
London
Valencia
Horta
Blacksod
Malin Head
Stornoway
Lerwick
Cuxhaven
Brest
Perpignan
Vienna
Funchal

Chart XIII. Weather Map of North Atlantic Ocean, March 16, 1926

(Plotted by F. A. Young)